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INCLUDING METALLURGICAL ABSTRACTS

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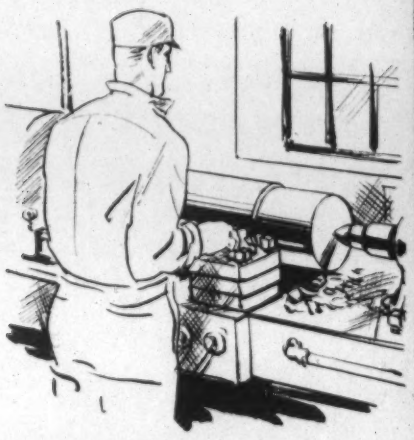

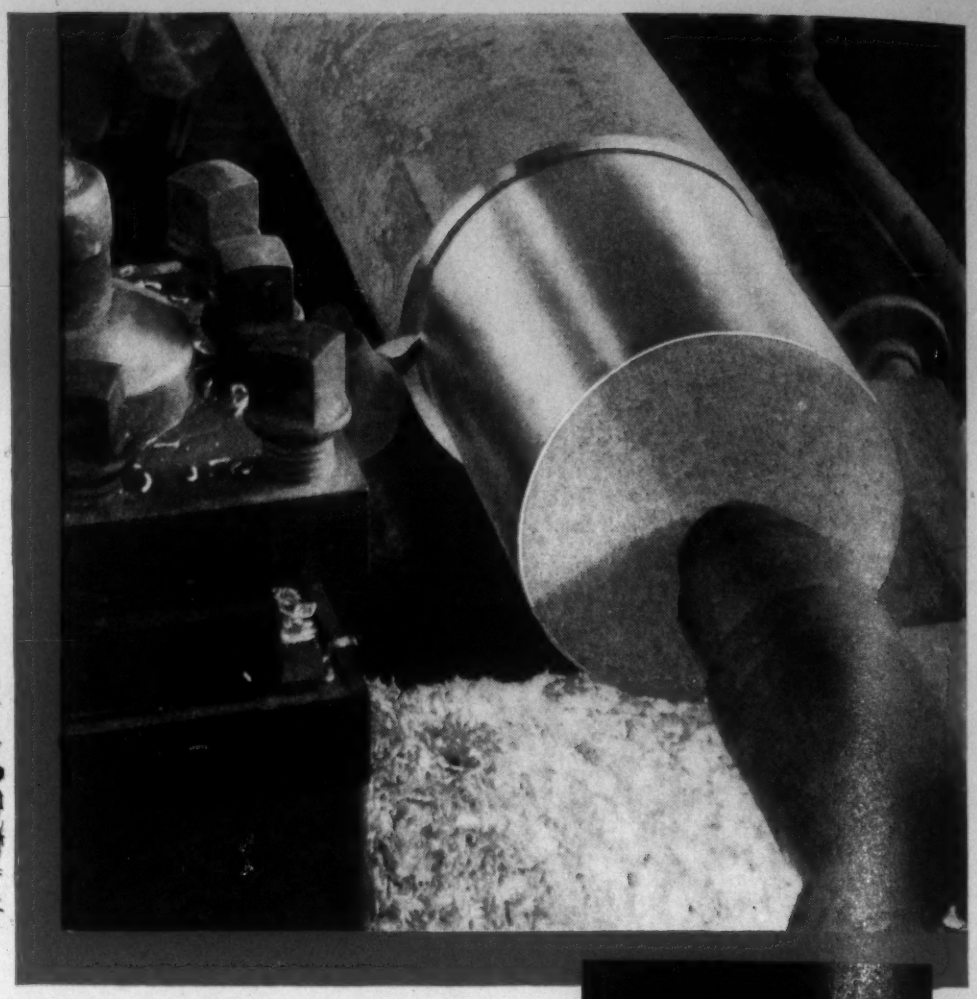

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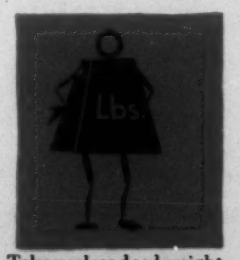

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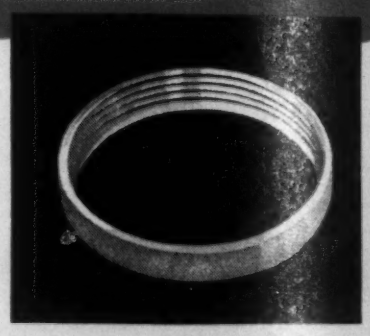

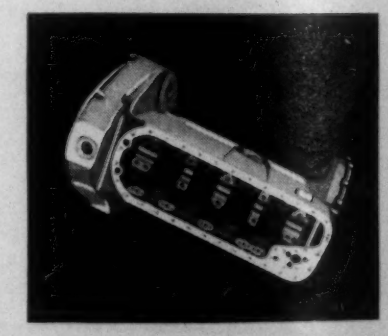

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EDITORIAL COMMENT

THE COATING OF METALS

FEW things in this world are used without some special preparation of the surface for the purpose in hand.

Paper is calendered to give it the proper finish. Houses are painted to protect them from the weather. Walls are papered. Flappers' faces are cosmetized. Glass is polished, cakes are iced, and so on for nearly everything one can think of.

Whether the coating or smoothing of the surface is for appearances' sake only, or to increase the life of the underlying material according to the slogan, "Save the surface, you save all," the proper preparation of the surface is an essential step in the manufacture of almost anything we want to sell. Metals are no exception.

Rust, tarnish, corrosion and abrasion are evil enemies that must be fought by the users of metals. All these attack the surface.

One way of defeating them is, of course, to find a material whose interior and surface both have the properties desired at those locations. But such a choice is usually a compromise, and even the corrosion resistant non-ferrous alloys and the stainless steels do not always have exactly the properties wanted both inside and out.

Usually a strong or a very readily formable cheap alloy for the interior, and a thin corrosion-resistant, wear-resistant or decorative film of another material on the surface, is the most economical combination.

The coating of metals is therefore a matter of importance to the producer and user of metallic parts, and one which the metallurgist must consider.

For utilitarian purposes, we have carburizing, nitriding, and the welded-on overlays, as well as chromium plating to resist wear, hot galvanizing, tinning, coating with terne, with lead, etc., sherardizing, calorizing, metal spraying, use of duplex metals of the Sheffield plate, Alclad and Niclad types, electroplating, anodic and allied treatments of aluminum, rubber coating by electroplating and otherwise, Parkerizing and oiling, and certain types of painting.

For combined corrosion resistance and for decorative effect, or for decorative effect alone, we have vitreous enameling, painting, varnishing, lacquering, Japanning, mere polishing of the surface, electroplating and polishing, coloring, dyeing of anodic films on aluminum and so on.

Some of these are meant to be as permanent as possible; others, like paint, are intended to be renewed at intervals.

Modern nitrocellulose lacquers and those of the Bakelite or other condensation resin type, with the different solvents, driers, resins and pigments in these and the older paints, varnishes and lacquers, are complicated subjects in themselves, and their permanence, gloss, hiding power and chemicals resistance are matters on which many technologists are putting long and careful study. Bronzing pigments and the increasingly important flake aluminum pigments, bring metallurgy into play in these coatings as well as in the materials to be coated.

Vitreous enameling has grown greatly in recent years, and only requires the development of an enamel with a little more flexibility to conquer even wider fields.

Electroplating took a sudden spurt when the chromium finish finally found favor, and the plating industry is slowly becoming a science instead of an empirical art. Problems of adhesion, pinholing and throwing power are grave, and the myriads of possible variations in plating solutions, current density, temperature, degree of agitation, in depositing this and that metal upon another make this, too, a very wide field.

The selection, cleaning and preparation of metal for taking any one of the various types of coatings must be done with a view to the coating to be used. Roughening the surface as by sand- or grit-blasting is essential for metal spraying and for some paints, and quite too little is known about sand-blasting.

Polishing of a metal itself, or of a plated coating, is an operation that usually involves an astonishing proportion of the total cost of a finished article. Too little is known about the polishing process or about why one polishing powder works well or poorly on a given metal.

Too often the metallurgical engineer views the question of metal coating as a problem for the chemical engineer. Instead, it is a joint problem, one that will benefit by coöperation between both chemical and metallurgical engineers.

In this issue, we discuss a few of the multitude of factors involved in the coating of metals, and we plan to give continual attention to this type of problems, believing that they are of greater importance in metallurgical engineering than most engineers recognize.—

H. W. GILLETT

EACH and every member of the Editorial Board of METALS & ALLOYS hereby expresses his warmest good wishes to you for a very Merry Christmas, and that the coming year will bring you all the successes and blessings and fulfillment of your strivings.

Engineering Demands for Metallurgical Research

The metallurgical research groups in universities and government institutions not directly connected with industry are guided by several influences in the selection of their research problems. Expediency—what topics can be handled with the funds, equipment and personnel available, interest—what the professor or supervisor and the student or worker may like to do, the needs of pure science as those in charge visualize them, and, finally, industrial need for new or more exact information, all play a part in the choice.

The problems selected for attack by the research laboratories of industry itself are chosen, and properly so, with a view to the dollars and cents value of the information to each particular firm. Many of the firms with long experience in research find it necessary, in order to build a sure foundation of fact, to delve deeply into the pure sciences that underly their particular industry, but delving in specific directions and for clearly understood purposes. To such an extent is this done that more work of real value in pure science along the lines of physics and engineering, at least, is coming from the industries than from the universities. Not only is this true as to the total amount of work, but, since the subjects are selected because of a real need and the work is carried through as far and at such a rate as appears to be a good investment, instead of being stopped when an interested professor retires or the funds allotted for university research are exhausted, the quality of the work is higher on the average.

Any firm, however, finally comes to the point where its own interest in going still more deeply into a given research field is somewhat remote, yet sufficient to justify its joining in to till it further with others with similar indirect interests in the field. Such general problems, as well as some of pressing commercial interest which lead to specifications and that sort of thing and so require joint action, are natural subjects for study by committees of national technical societies. The financing of joint problems of this sort presents difficulties and there are other difficulties due to the multiplicity of counselors.

When all feasible joint action is taken, another borderline is reached where the industries are, in general, no longer willing to give appreciable financial support, but are willing to suggest the research lines they would like to see others, especially the universities, follow.

While such suggestions may fail to include the more immediate and vital problems that are under study in the laboratories of the industries themselves or slated for such study, yet they are of interest as showing some of the subjects on which industry feels a need for more research information.

Such a list of engineering research subjects has been secured, in reply to a questionnaire, by the Committee on Engineering Research of the Society for the Promotion of Engineering Education, and is published in a Supplement to the Journal of that Society, issued February 1931, pages 107-131.

Some of the replies were written with an appreciation of the fact that the Engineering Experiment Station or other research group at most engineering schools is severely limited in funds, in time of the instructing staff available for the direction of research, in available workers of sufficient maturity, and especially in workers who can apply full time and energy rather than a patchy kind of attention between classes, hence, these replies mention only subjects that might receive useful attention despite these handicaps. Other replies obviously do not take these limitations into account and list problems that are plainly out of the scope of many institutions, such, for example, as one "Engineering Experiment Station" created in 1907, whose available funds for research for 1929-30, as listed in another part of the Journal cited, amounted to the gorgeous sum of $700.00.

Without discussing here how far such engineering research groups are likely to get, if and when they do attack the problems, the subjects suggested are worth glancing at. It is enlightening to see how many of the subjects mentioned deal with metallurgy. Indeed, comparing the ratio of purely metallurgical problems that have been or are being studied by university engineering research groups, as listed in the Journal, to that of the list of problems put forth by industry, it seems plain that metallurgy is getting less attention from such groups than industry advises giving to it.

The firms whose engineers responded to the questionnaire with fairly specifically worded subjects were American Brass Company, Atlantic Refining Company, Belden Manufacturing Company, Cochrane Corporation, Crucible Steel, Chrysler Corporation, De Laval Company, Detroit Edison Company, Du Pont Company, Hoover Company, International Harvester Company, New Jersey Zinc Company, Radio Patents Corporation, A. O. Smith Corporation, U. S. Radiator Corporation and Westinghouse Company. Some subjects previously suggested to the American Society of Mechanical Engineers by industry were also included. Only three of these firms would class directly as producers of metallurgical materials; all the rest fall into the user class.

Several firms mentioned the allied problems of wear and friction and lubrication of bearings, while abrasive wear, such as is met in dredge pumps and in handling powdered coal, interested others. Brake drum wear and friction of drums and linings, as well as the general problem of determination of coefficient of friction, abrasive wear and saving of energy lost through friction of soil and tool in farm tools, and the selection of abrasives for specific grinding problems were also mentioned as important.

Corrosion problems specifically mentioned were: caustic embrittlement, effect of deaerated water, the effect of impurities or additions of Al, As, Si, Zn, Sn, Mn, Ni, on the corrosion of copper, corrosion by high sulphur crude petroleum, by sulphur gases, etc.

The need was expressed for more information on the properties of metals at high temperatures, study of engineering design based on plastic flow, effect of varying temperatures and stresses as contrasted with the usual high temperature creep test, and thermal conductivities at high temperatures.

Mechanical hysteresis or internal friction in respect to resistance to repeated stress, mechanism of failure of metals, and studies of the effect of rate of loading in various mechanical tests were mentioned.

Machinability in all types of metal cutting, the characteristics of metal cutting in general, various problems in regard to deep drawing, stamping and forming, both from the point of view of the operations themselves and of the selection of materials most readily cut or formed, were important in the eyes of several.

Some general subjects for attack from the experimental and theoretical point of view were: elastic coefficients, electrical conductivity, more accurate equilibrium diagrams, study of volume changes during solidification, and the effect of gases and inclusions in steel.

A few more specific problems were: selection of suitable steel for dies for aluminum die castings, means for determining the true softness of copper magnet wire, maintenance of the film in electrolytic condensers, study of radiation from fins of copper, aluminum, steel, cast iron, etc., use of bronze in welding iron and steel, reflective properties of chromium plating, etc., and how best to fasten wire ropes.

It is evident that those factors which make for too short life in severe service under abrasive, corrosive and high temperature conditions, bulk large in the eyes of engineers.

Knowledge on friction and lubrication problems, too, is apparently not yet in a state that satisfies the engineer.

Most of the problems mentioned require the combined points of view of the engineer, the metallurgist, and the physicist, and many of them, the study of high temperature properties, for example, call for rather expensive equipment and uninterrupted effort, which only too rarely can be supplied by universities. It is a pity that our engineering schools do not attract more graduate students who might be competent, under suitable direction, to handle such projects, and that so few schools or engineering experiment stations make research a full-time task for certain professors and capable workers. Until this situation is remedied, about all that can be hoped for is a better realization of the possibilities of research in engineering metallurgy by the faculties of physics and chemistry, since those sciences attract many graduate students who would really be better prepared for later work than they are by working on the problems normally selected by their teachers, if they coöperated in research along the lines mentioned above as desired by industry and along similar lines on which any university could ascertain the desires of industry.—

H. W. Gillett

Good Will

The older we get, the more impressed we are by the fact that people in general, and technical men in particular, don't get paid solely for what they know or even for what they can and do accomplish technically, but also, and to no small degree, for the way they get along with other people.

A man who is himself pretty much of a light-weight scientifically, but who has some horse-sense and who has the faculty of making friends that will be glad to help him out when he needs help, is, as a rule, far more useful to an organization than the "prima donna" type of genius who can't and won't work with others.

There are a few university professors and even an occasional public official, who not only used to have high scientific standing in their younger days, but were also well liked, who are lately slipping badly in the esteem of their fellow scientists solely because they have acquired an ingrowing sense of their own importance, and have become overbearing in their discussion and criticism of the work of others. We recall one such discussion at a technical society meeting where a professor criticised a paper, the conclusions of which were admitted by the author to be open to discussion, but which were at least worthy of thought and further study. The professor could have couched his criticism in such a fashion as to make plain that he disagreed totally and that his scientific honesty forced him to present the other side of the picture in an impersonal fashion, but that he recognized that the author not only had a right to his own interpretation, but also was doing a service by presenting his results and opinion. Instead, he phrased his criticism in such a fashion that his hearers felt that his opinion of the author was that the author was a fool and hence that nothing in this paper could deserve credence. It was not a discussion; it was a diatribe.

The result was that every one in the audience rallied to the support of the author whether they agreed with his conclusions or not. In ten minutes, that professor earmarked himself as a sour and unfriendly spirit, losing his own prestige, and boosting that of the man he was attacking.

We recall another technical meeting at which there was presented a rather amateurish account of some sketchy undergraduate work at a small college, done under decided handicaps as to equipment and guidance. After some criticism, fairly well deserved and not of a vituperative nature, but which nevertheless would tend to dispirit the youngsters and their teacher, Dr. Whitney remarked that some of the observations of the authors opened up useful fields, and that the society should en-

(Continued on Page 336)

AGAIN unforeseen conditions have forced us to omit the metal cover on this issue. Through the courtesy of the American Brass Company we received a sufficient quantity of Everdur (0.1 inch thick). This material was shipped to the Cold Metal Process Company to cold roll down to 0.002 inch. The processing, to provide the material with properties suitable for our cover, requires cold rolling to 0.01 inch, then annealing in a bright annealing furnace and finally cold rolling to 0.002 inch. The Everdur will therefore be used on our January issue.

The Japanning of Steel

BY WILLIAM J. MISKELLA*

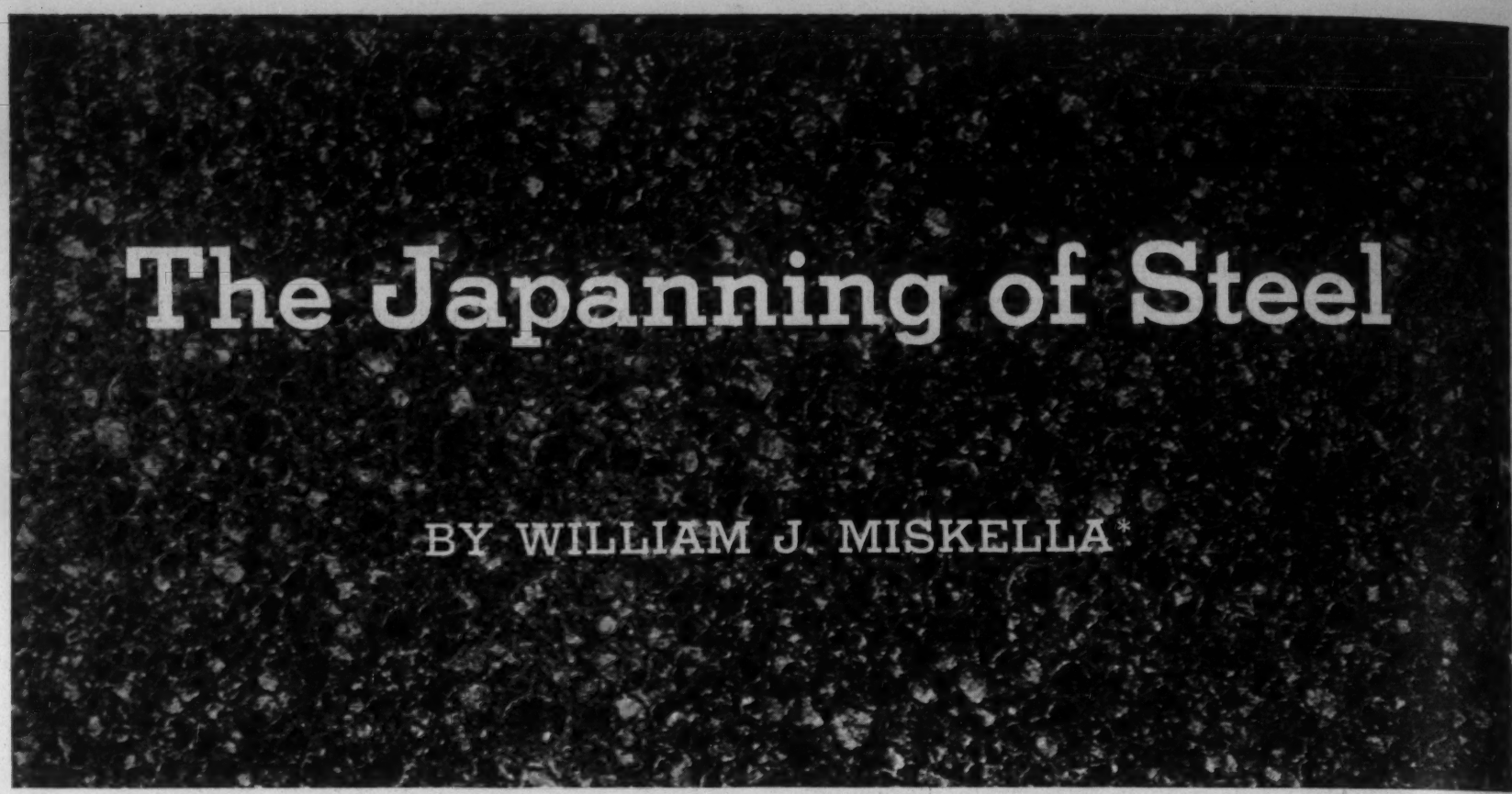


Fig. 1. Crystal Japan (Actual Size).

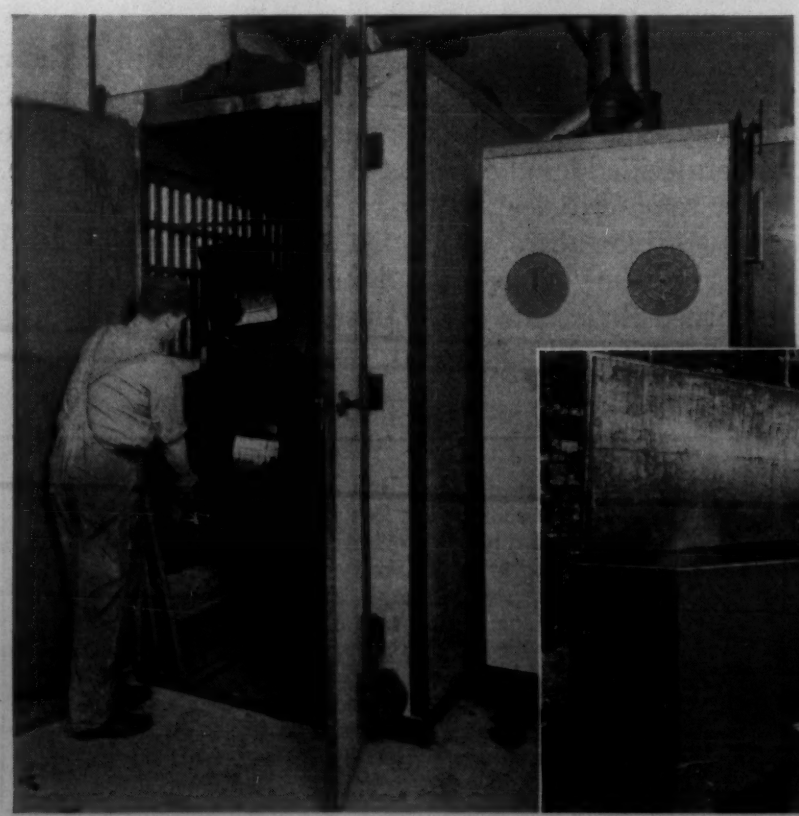
THAT japanning is an important type of metal finishing is confirmed by the fact that eleven standard forms of conveyor-type ovens have been developed within the last fifteen years for handling the large volume of parts which are finished by this most interesting process. Of course, this does not cover the entire field for there has been designed special equipment for automatic handling as well as a large variety of stationary type.

Who can say that the field covered by this durable and popular finish would not have been widened had it not been for the narrow-minded policy of those in the job-japanning business in the early days. Then the japanner thought he had something no one else knew much about—and he did, but that did not bring in volume business. In those days very few manufacturers had their own japanning departments and the secretive methods with which the job-japan shop was conducted, as well as the manner in which the formulae for making the various types of japan were guarded, surely retarded the industrial application of a finish which has many interesting properties.

Production demands of the automobile industry forced the issue and created the need for the continuous finishing of metal parts in order that costs might be reduced, quality might be improved and most important of all speed in finishing be introduced. To show just how successful this demand was in upsetting the order of things—it was the standard practice in job shops 15 or 20 years ago to take 24 hours to pass through the cycle of applying one coat of japan. To-day it is possible to duplicate the same process, and obtain better results, in one hour.

Just what is japanning? This is a pertinent question and one which is difficult to answer for the little literature which is to be found on the subject is so confusing and there are so many conflicting statements that is it really difficult to know what is authentic. There is no other finishing material just like japan in its make-up. Japanning could be defined as a process of applying a mineral coating to metal surfaces—a coating which deteriorates less with age than any other known material applied in liquid form. Japan looks like paint and is often

* Consulting Engineer on Finishes and Finishing Problems, Oak Park, Illinois.



Box-type oven for small jobs.

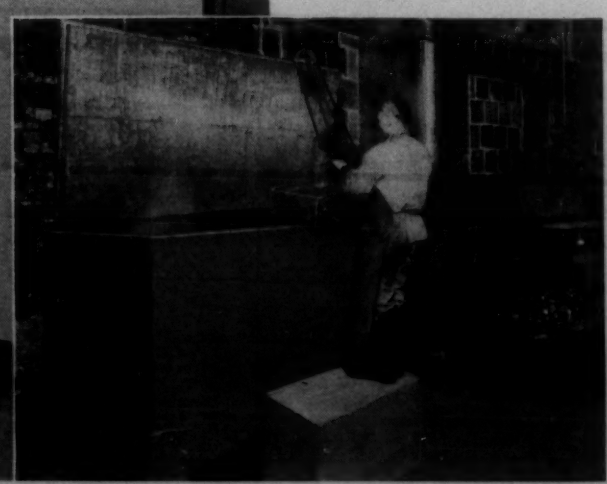


Fig. 3. Semi-automatic for handling small parts.

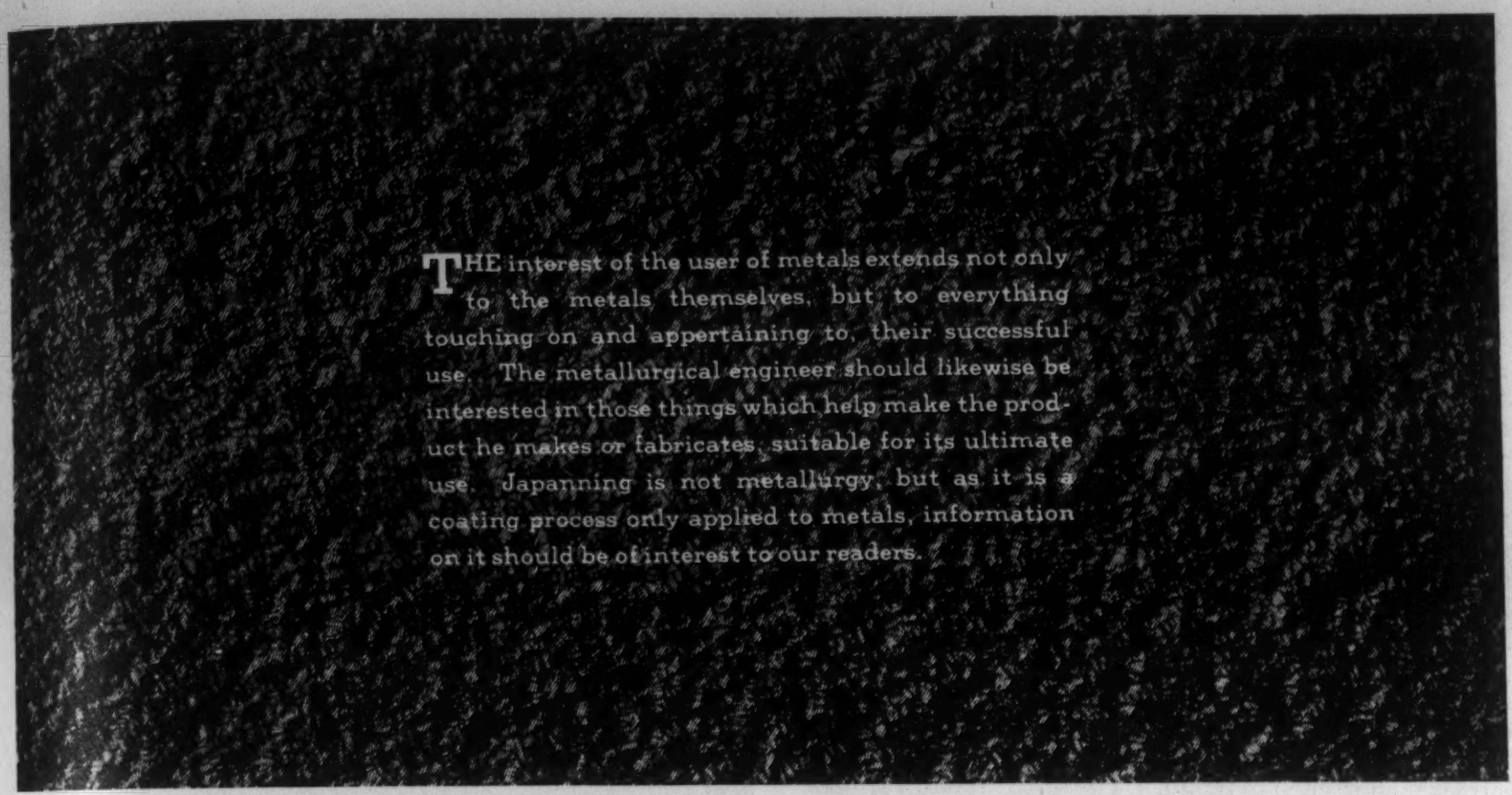


Fig. 2. Crinkle Japan (Actual Size).

erroneously called paint, yet it is as unlike paint as water is unlike oil.

Paint is a coating material made up of a pigment which gives it color, a drying oil which gives it life, a drier which hastens its hardening or drying stage and a reducer which conditions it so it may be readily applied. The duration of the existence of the paint film rests with the life of the drying oil—when that ends the paint disintegrates and chips or falls off—and all within a few short years.

Baking japan also contains all of these ingredients in one form or another with the one exception that the pigment used is peculiar to baking japan and differs materially from that used in paint. This pigment is obtainable in a variety of black shades, but always black for there are no colored japans in the true sense of the word—the colored finishes are enamels. The pigment is not affected by the heat used in the japanning ovens. Japan is a member of the asphalt family and is known as gilsonite.

There is another difference between paint and japan. In paint the drier used is a chemical which acts on the other ingredients to hasten oxidation of the film on the surface of the article being finished. In the japanning process no drier is used but the baking oven capable of supplying heat up to 400° F. performs the same function that the drier does in paint. Paint without drier and japan without being baked would otherwise take weeks and weeks to dry and even then there would neither be the same ultimate result or anything like the same quality of finish, and the finish would always be sticky to the touch.

The heat in the japanning oven causes the material to flow together in a smooth uniform coat as is seen on practically every automobile fender (black finished). Once the japanned parts have passed through this baking process they receive—when properly applied—the most durable and highly satisfactory metal coating in existence. Besides the automobile fenders, typewriters, sewing machines, stove parts, airplane engines, calendar pad holders, hardware items, various toys, etc., are all black japanned.

From the standpoint of cost it is the cheapest known metal finish there is and by far the most durable, not even excepting nickel plating, pyroxylin lacquer or spar

Electric Oven of the truck-type.

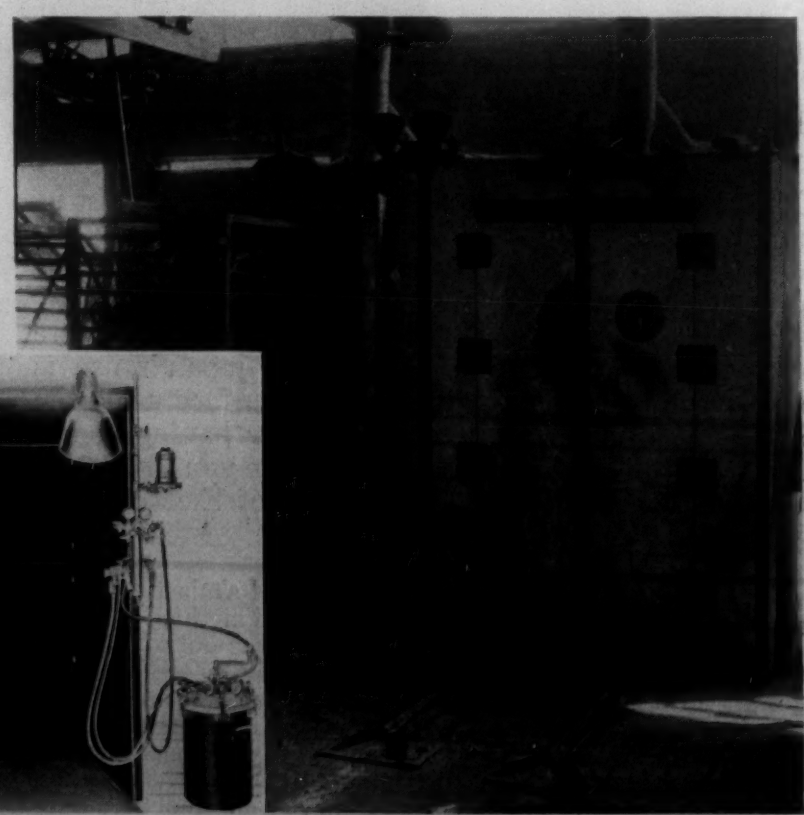
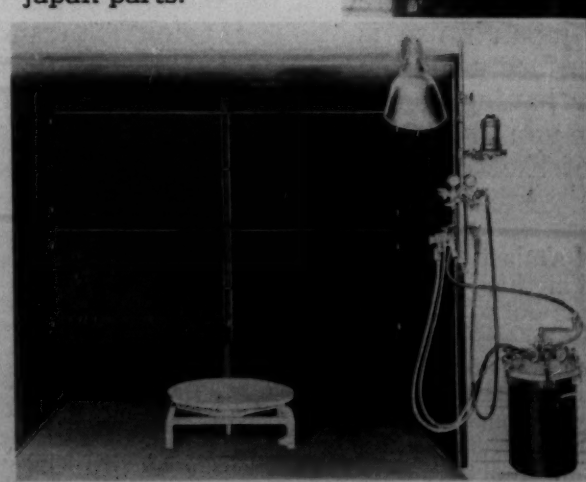


Fig. 4. Modern-type Spray Booth with distributing plates in the back for collecting the waste when spraying japan parts.

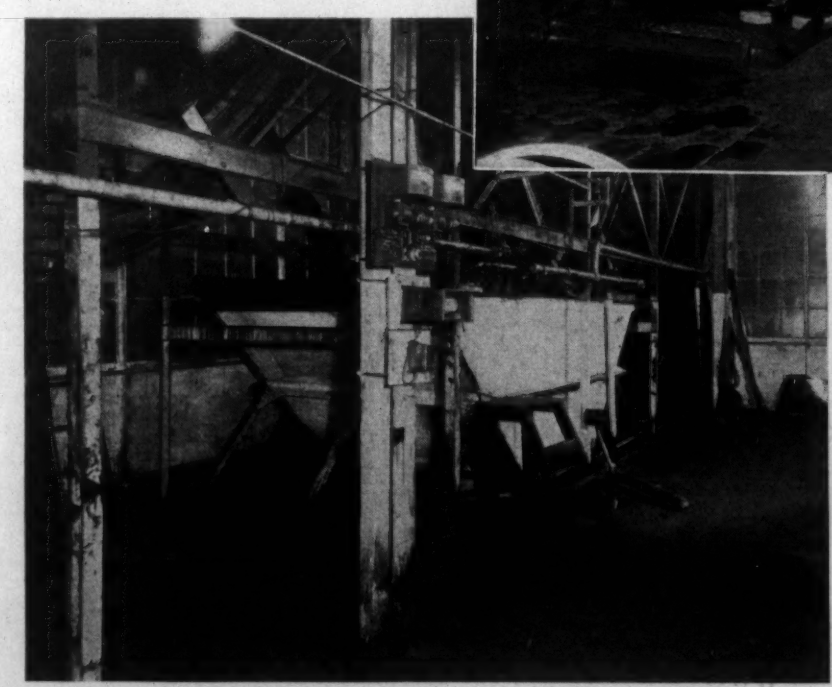


varnish. It cannot be applied to wood or any material which cannot stand being baked at a minimum of 325° F. This leads to the definite classification of baking japan. All materials which are applied and baked at temperatures below 325° F. are not japans.

Naturally one would infer that the process had its origin in Japan, but, evidently it did not for it is recorded that in the beginning of the third century the Japanese made an expedition to Korea which was then a Chinese possession and took back with them to Japan a lac tree which they naturalized and later commercialized. There is no connection whatsoever between the japan of to-day and this ancient lac tree—only the origin of the name. This statement does not apply to japans alone but includes driers, varnishes, enamels, lacquers and other similar finishing materials. The real oriental lacquers are produced from the sap of the lac tree and are marketed under different names, as Chinese, Japanese, Foochow, Cinnebar, etc. The lacquers of our industrial markets are known as pyroxylin or nitrocellulose lacquers. These are chemical compounds—an American invention—made from cotton and corn raw materials. (I might mention the lac tree of Japan is similar to our American sumac.)

Japan used to be called "japan varnish" but soon the term was shortened to japan. The term "japan varnish" is used in one of the oldest United States patents, taken out in 1856 and assigned to the Howe Manufacturing Company of Derby, Connecticut. This interesting patent covers the japanning of pins and reads just as if it were taken out yesterday, with the exception of the term 'japan varnish."

Burn-off Oven at Marmon Motor Car Company (Courtesy Young Brothers Company).



Dip Tank and Second Coat Dip with Japanning Oven at Marmon Motor Car Company (Courtesy Young Brothers Company).

The test for japanned articles may be made as severe as possible, providing, of course, the japan finish is properly applied on a perfectly clean surface using the proper materials and under the proper baking conditions. As an example of this let me give you the standard specifications of the Department of Electricity of the City of Chicago:

All surfaces of the tube should be protected against corrosion by one of the following or some other approved method:

The japan coating on either the inside or the outside surface of the finished conduit must not soften at ordinary temperature. It must have an even and smooth appearance and must be of uniform quality at all points the entire length of the tube. It must be of sufficient weight and toughness to resist smashing or flaking and must be of sufficient elasticity to prevent its cracking or flaking at any time up to one year from the month of manufacture when $^1/_2$-inch conduit is bent in a curve, the inner edge of which has a radius of three and one-half inches.

The japan coating must not be seriously affected by soaking at 70° F. for 24 hours in any of the following aqueous solutions:

1. Sulphuric acid of 1.3 specific gravity containing 40% by weight of anhydrous sulphuric acid.
2. Commercial strong hydrochloric acid containing 20% by weight of anhydrous hydrochloric acid.
3. Acetic acid containing 20% by weight of anhydrous acetic acid.
4. Saturated solution of carbonate of soda containing 20% by weight anhydrous carbonate of soda.

Japan drier (also called japan driers and sometimes just driers) is a colorless liquid which itself dries to a hard film having considerable coherence. Its principal use is as a vehicle for grinding coach painting colors. Colors which are bought by the user are, for example, red ground in oil, or red ground in japan, or even red ground in varnish. Colors which are ground in japan dry much quicker than colors which are ground in oil.

It should be understood that japan drier does not enter into the formulae of baking japan in any way whatsoever. Japan drier is used in air-dry paints to chemically hasten the drying, while heat, through the medium of a japanning oven, is used to hasten the drying of baking japan. (And let me add here that the addition of drier to any kind of paint is considered a detriment and shortens the life of the coating, but regardless of this fact there are places where it must be used.)

"Rubber" japan receives its name from its similarity in appearance to hard rubber. Dull black japan is a form of "rubber" japan that is devoid of gloss. The dullness is due to the amount of pigment ground into the vehicle or liquid by the manufacturer and secondarily

to the degree of heat applied in the baking process. Dull black japan is used on most telephone stands the world over. "Rubber" japan is used as a first coat because of its binding and covering quality. Literally it seems to flow into the pores when the metal to which it is applied expands within the oven during the baking process. A typical formula for "rubber" japan is:

Black japan	3/8 gallon
Turpentine	1/8 gallon
Kauri varnish	1/4 gallon
Carbon black	1 pound

There are a number of different shades and grades obtained by varying these proportions and by intermixing gloss black baking japan with rubber black baking japan. The latter is really gloss black baking japan with enough carbon black pigment added to deaden its gloss. Then sufficient turpentine is added to reduce the mass to working consistency. The Kauri varnish is included to assist in grinding the carbon black into the mixture. Incidentally the carbon pigment often settles upon standing which means that a "rubber" solution must be stirred, or agitated, before using.

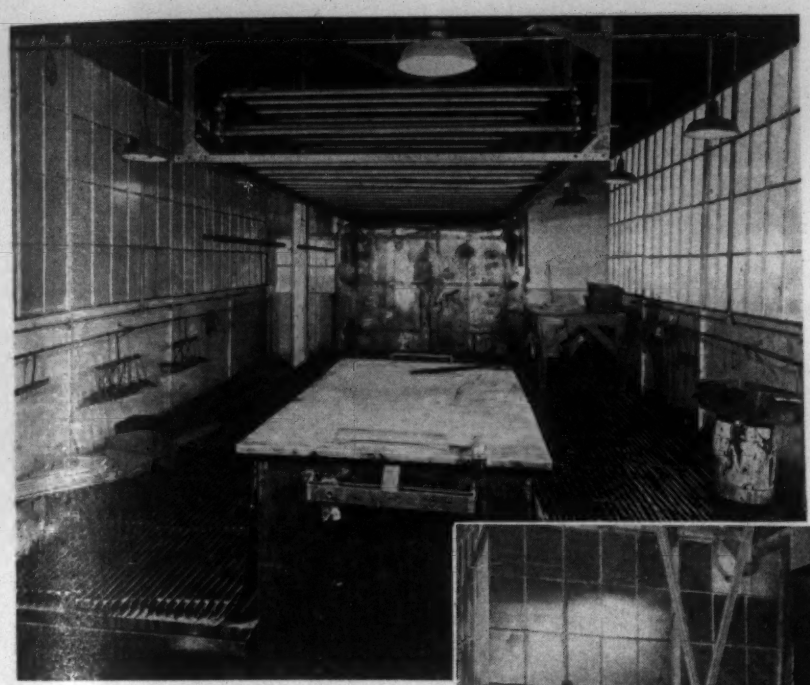
Sometimes streaks and strips are noticed in "rubber" coated parts after they have been dipped. This defect is due either to poor mixing or grinding at the factory or to insufficient agitation prior to use. It is the pigment that furnishes the covering and opaque quality to "rubber" japan. It looks very much like Bower-Barff.

The real Bower-Barff finish which is said to be rust proof is used on much of the high-grade building hardware. It is named after the originator. The real process is performed as follows:

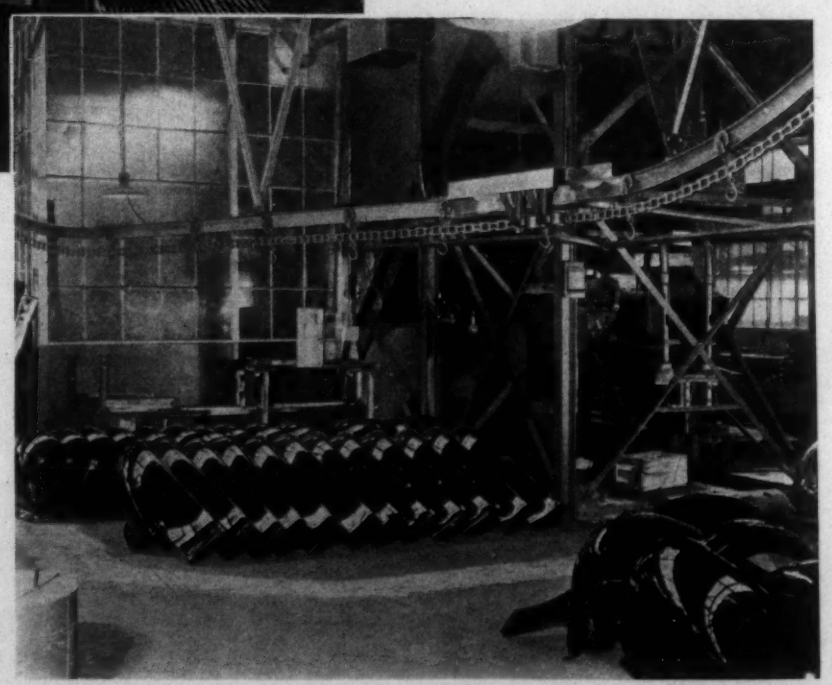
The iron or steel articles should be chemically clean and given a light sandblasting. They are then placed in a closed retort or furnace where they can be heated to cherry red—about 1250° F. When the articles have reached this temperature super-heated steam is injected into the retort, which develops a black magnetic oxide of iron upon the steel or iron. It takes several hours to produce a good coating. When cool the surface is wiped with a thin coat of linseed oil and then heated at 212° F. until the oil becomes dry. This changes the magnetic oxide to a slate gray or the regular Bower-Barff finish.

This process is a close imitation of dull black baking japan. It is so good that it is difficult for one not an expert to tell the difference.

Black baking japan (which is also called Brunswick japan) is the most popular and also the most used japan. It may be applied as a filler, over "rubber", or over itself, but it is more often applied alone. It has a glossy appearance, is hard and smooth when it comes out of the oven and keeps that appearance under the most adverse conditions. It is very elastic, is non-conductor of electricity, is acid-proof and water-proof. It is also alkali-proof to a certain extent. It is usually shipped in five-gallon cans or in fifty-gallon drums. It does not settle or separate and does not have to be stirred, except just after being reduced with benzine. Black enamel differs radically from black japan because it is really a varnish.



Intermittent Conveyor Showing Dip Tank and Drain Board used with Intermittent Japanning Oven at Marmon Motor Car Company (Courtesy Young Brothers Company).

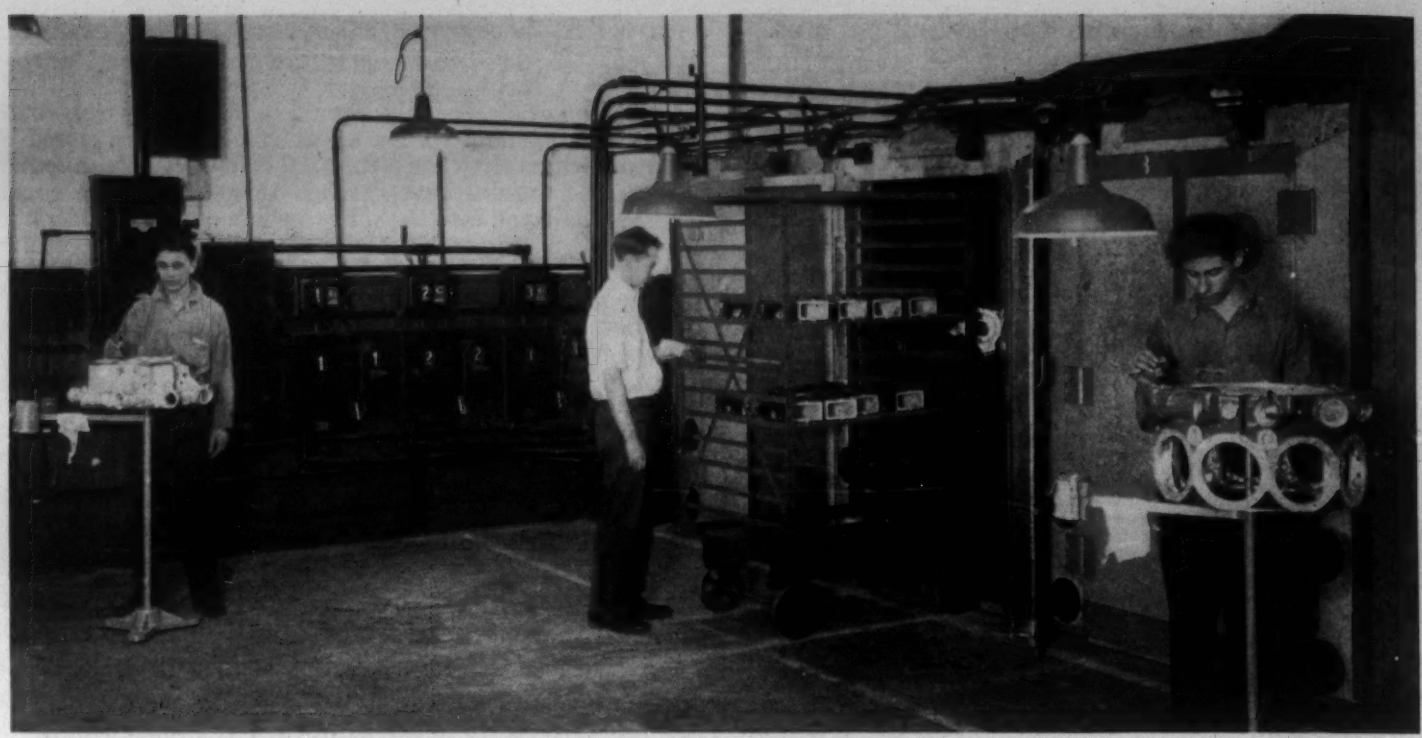


Overhead Trolley System for Handling Fenders at Marmon Motor Car Company (Courtesy Young Brothers Company).

And now let us consider some of the crystal japans, which are popularly—though erroneously—known as crystallizing lacquers. These finishes are really very beautiful; and, as the name indicates, are finishes having an alligatoring or crystal effect, as shown in Fig. 1. They are used quite extensively on precision instruments, camera parts, radio parts and the like. Even larger articles are now being finished with these finishes such as scales of various kinds, store fixtures. Some metal-casket manufacturers are applying them to caskets in various colors—dull bronze, lavender and black and they are very beautiful indeed.

The material should always be bought fresh and from a reliable manufacturer. There is a certain manipulation of the oven which is necessary to produce these crystals which are a mixture of alternate dull and shiny spots between the wrinkles caused by the raw oil used in the material.

The oven must be brought up to a temperature of



Electric oven—The heat of the air-cooled engine cylinder does not burn off the japan coating on the airplane motor castings being japanned.

100° F. and kept at that point for about $^3/_4$ hour. During this time the air intake vents are closed and the work is kept in darkness. At the end of the stated time the crystals are formed, then the vents may be opened and the temperature raised to 350° F. for $^1/_2$ hour. (It could be baked at 250° F. for 2 hours.) This material is best handled in an open-flame type gas japanning oven since it is the sulphur in the gas and lack of oxygen in the oven which is necessary to aid in producing the crystals. The heavier the coating the larger the crystals will be and vice versa.

This crystallizing effect can also be produced in colors by using clear material, as above, without pigment, on whatever color of background one desires, care being taken not to bake at high enough a heat so as to harm the background material. Beautiful and artistic color effects may be gotten by intermixing colored crystallizing lacquers or in shading crystallizing colors by adding black crystallizing lacquer.

Another type of finish similar to crystal japan is called crinkle japan and is illustrated in Fig. 2 This finish is secured by placing the freshly coated parts into a very hot oven. The oven used should be of the indirect type, which means that pure air and not foul air is essential—thereby differing radically from crystal japan. However, a direct oven will produce the crinkle effect.

There are a number of processes of applying japan, including brushing, dipping, spraying and roller coating, but the two principal processes are spraying (Fig. 3) and dipping (Fig. 4).

In Fig. 5 is illustrated a continuous conveyor, which, as the name indicates, provides a continuous system of finishing. The parts to be finished are hung on the loading end of the conveyor and once in position are carried through the entire process, finally reaching the end of the system where they are unloaded and packed ready for shipment. The freed conveyor chain continues back to the starting point where it is available to take up another load of parts.

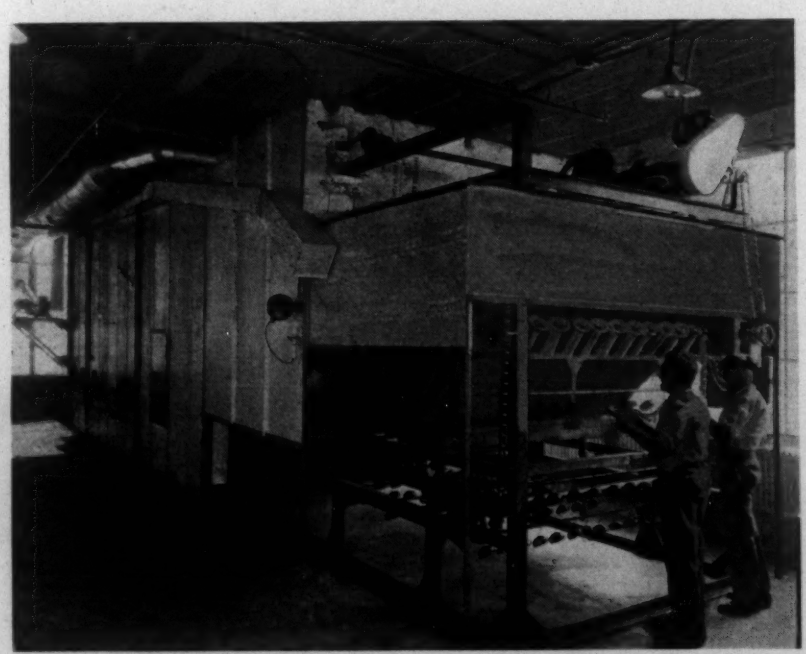


Fig. 5. Continuous conveyor oven for handling small parts.

Some continuous conveyor ovens, called the A-type because of their form, are shaped just like the letter "A." These ovens are the result of various experiences and designs and are now said to be the last word in japanning ovens from an efficiency standpoint. The curves shown in Fig. 6 explain this most fully. Please note that the 2 curves are also "A" type and that the hottest point or peak is reached at the top or apex of each unit.

As the temperature decreases, the location of the work on the conveyor approaches closer and closer to the end of the oven's units. The shape of these units holds the hot air within the oven so that it cannot escape without giving up its useful energy. Thus, all the heat that it is possible to reclaim out of a certain heat application is redeemed.

Two of these "A" units are placed in series and are connected by a common continuous conveyor moving at the rate of 16 inches per minute (in the installation covered by the curves). They have a capacity of approximately 140 tons of two-coat work per day. The installation is about 200 feet long, 8 feet high and 10 feet wide. Each of the two dip tanks have a capacity of 5000 gallons of coating material. Both are equipped with mechanical clarifiers.

Of course, it is highly desirable that an outfit such as this be practically independent of weather conditions, so

Continuous single strand-type oven and conveyor.

air is introduced in the baking compartment closely controlled as to temperature and purity. To accomplish this feat the air is supplied by power-driven fans which force it through steam coils where it is brought to a predetermined temperature and then passed over reed filters to remove dust and other impurities.

Thus it will be seen the degree of quality of the work depends upon the equipment used as well as the grade of material and the care taken to do the actual work. Even the air supply from the filter enters the oven room under pressure at three separate receiving points. Means is provided to determine the direction of flow within the oven which, of course, must be counter to the direction in which the work travels. This allows an interchange of heat between the air and the work and subsequently reduces the amount of fuel required to produce a given result. It also reduces the amount of smoke and fumes within the oven which results in the elimination of condensation within the oven, ideal baking conditions and a high degree of safety, for be the reader reminded that one of the factors which held this japan finish down for years was the explosion hazard present when the heavily coated parts were confined for baking in an oven not equipped with safety features and other refinements which have since been found necessary.

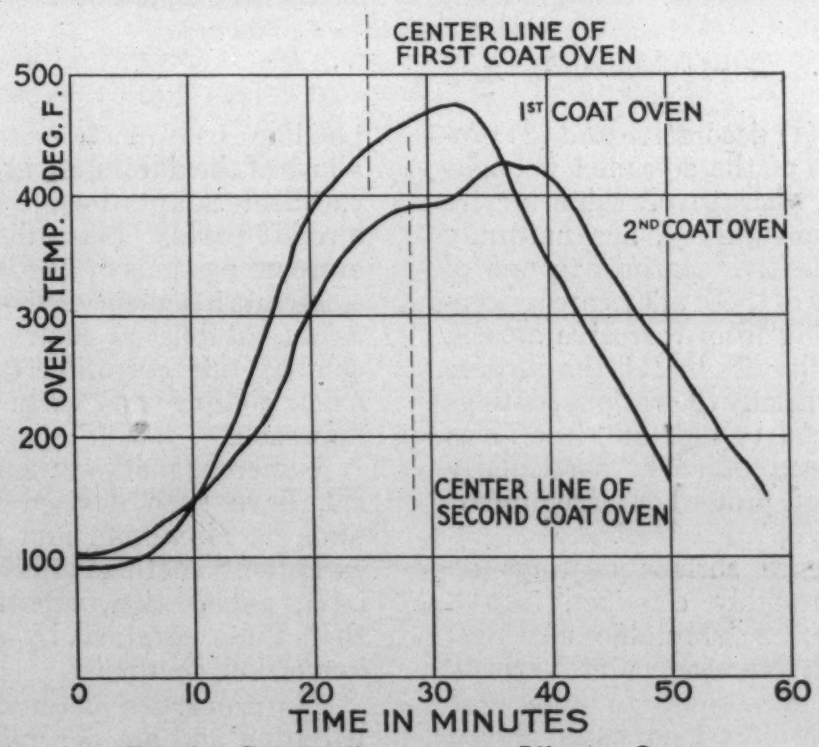


Fig. 6. Curves illustrating "A"-type Oven.

Much time and money has been spent in trying to make japan do the work of smoothing the metal upon the theory that the coating would flow into the uneven surface spaces and make it perfectly smooth. But this is an impossibility. The fact is that this type of finish depends upon the smoothness of the metal surface to begin with. If the surface is not smooth—before the coating is applied—then the japan finish will make the unevenness perfectly obvious and vice versa. In other words the finish will follow the contour of the metal.

Space will not permit of going into detail as to the sanding and cleaning of the metal prior to finishing nor into the subject of application via the various methods, such as dipping, tumbling and especially spraying for which there are as many different types of spraying outfits as there are articles to be sprayed.

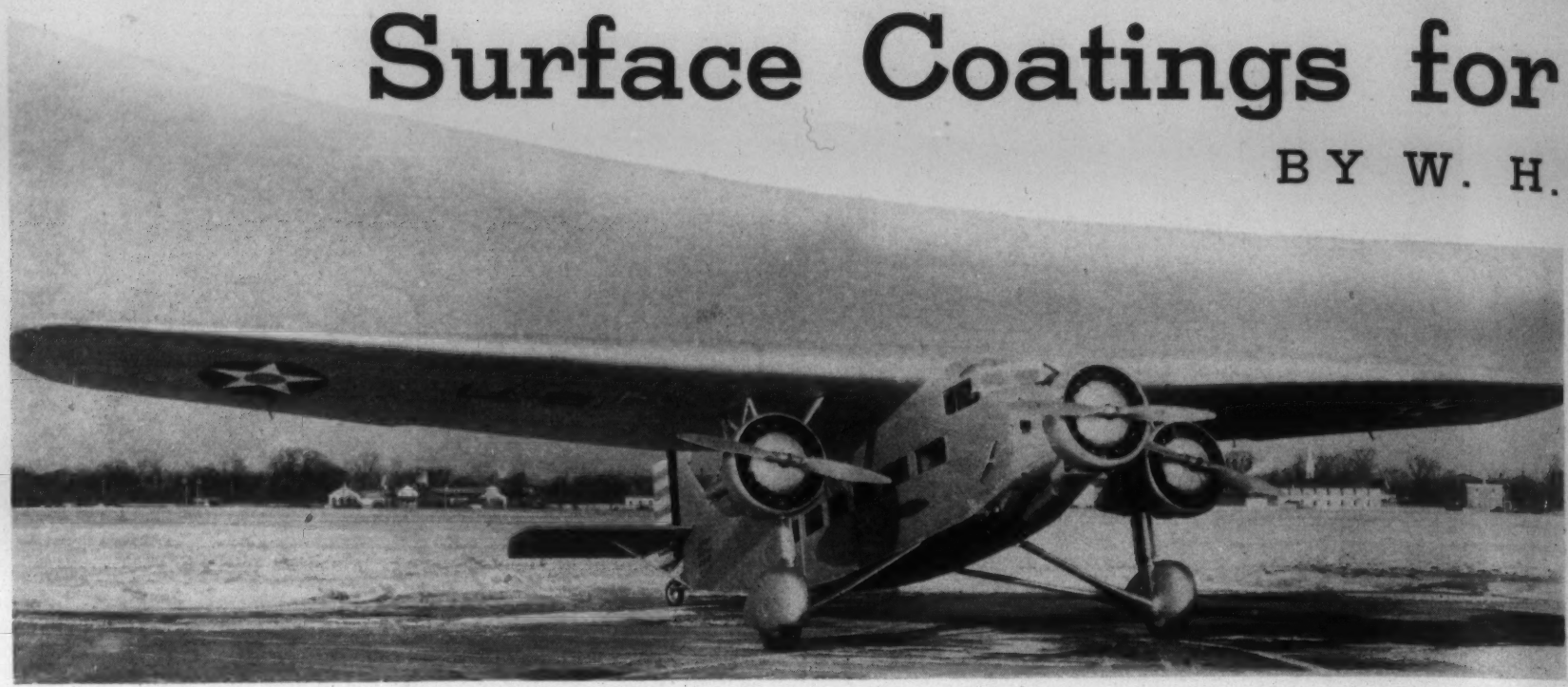
There are also many types of ovens which may be heated by various means, gas, electricity, coke or fuel oil but the specifications which govern the design features of ovens may be listed as follows:

- Size of oven
  - Number and size of parts
  - Number of parts for each bake
  - Time of bake
- Temperature
  - Process and
  - Kind of material used for heating, gas, oil or electricity
  - Time of baking
- Heat capacity
  - Time
  - Load
  - Temperature

In spite of the remarkable progress made in japanning there is still much to be accomplished and a goodly portion of this is scientific research on the joint action between the metal and the coating. Very little basic research work has been done on japanning aside from getting by with results which are derived from actual experience in production and use. This is a very expensive way to experiment but happens to be about the only way progress has been made in this particular branch of the finishing field. Little, for example, is known regarding the coefficient of expansion of the finish in respect to that of the metal, aside from the guess that it is very close to that of steel.

Surface Coatings for

BY W. H.



NATURE conveniently and promptly provides an oxide coating on all aluminum exposed to the atmosphere even for an instant. Nature can be improved upon in this respect, however, for oxide coatings and surface coatings of other types can be applied to aluminum alloys, to give superior protection or interesting and attractive decorative effects. A review of the art in this field is presented by the author.—Junius D. Edwards.

OUTSTANDING among the metallurgical contributions to progress has been the development, within the past 20 years, of the lightweight, high-strength aluminum alloys. Concurrent with their diverse utilizations there arose a demand for surface coatings of 2 fundamental types; namely, (1) decorative and (2) protective. The widespread use of the so-called wrought alloys in the aircraft industry, where severe saline service conditions are frequently encountered, has naturally elevated the problem of protective coatings to one of major importance, since many of these alloys are susceptible to embrittlement resulting from corrosive attack, especially in the presence of chlorides.[1] It is the purpose of the present paper to review briefly the various coatings in use at the present time and to indicate, insofar as is possible, the relative merits of each, particularly with regard to the degree of protection they might be expected to afford.

For purposes of convenience surface coatings on aluminum alloys may be roughly classified into 3 groups: 1. Oxide coatings; 2. Metallic coatings; and 3. Organic coatings such as grease, paint, varnish, lacquer and enamel. It is of interest to note that research and theoretical considerations have played an important rôle in the production of satisfactory coatings, particularly those of the first two groups.

OXIDE COATINGS

Although it had been known for many years that aluminum was itself quite resistant to ordinary atmospheric conditions, and that this resistance was related to the natural presence of an adherent and relatively impervious oxide film, the protective merits of artificially produced oxide films received but little attention at the hands of investigators. Experiments as early as Faraday's time had revealed that the natural oxide films could be measurably increased in thickness by making the metal an anode in a suitable electrolyte. Cognizance was first taken, however, of the insulating properties of the artificially produced oxide films and their subsequent uses were practically confined to electrical fields, for example, in the construction of rectifiers, lightning arresters, condensers and the like.

The post-war development of aircraft resulted in intensive investigation of the alloys of aluminum for possible use in aeronautical fields. Heat-treatable alloys of the duralumin type appeared to offer unusually excellent adaptations for both interior and exterior aircraft parts. This initial optimism was replaced by extreme pessimism, in many instances, once the corrosion-embrittlement of the alloys was generally accepted as an established fact. In the efforts to effectively combat this corrosion the production of a resistant oxide coating was early recognized as an avenue of approach.

Numerous methods, both chemical and electrochemical, have been devised for the production of oxide films on aluminum and aluminum alloys. With few exceptions, coatings produced by electrochemical means i. e., anodization, afford better corrosion resistance than those obtained by purely chemical, i. e., simple immersion, methods.

The properties of the oxide films show considerable variation and are dependent upon such factors as the composition of the alloy to be treated, the composition and temperature of the solution employed, and, in the electrolytic processes, the applied voltage. The latter may range from a few volts to as high as 500 volts. A few of the films, in addition to their insulating and corrosion resistant properties, provide an excellent absorbent surface for dye, paint and oil, which renders them the more useful for purposes of decoration or protection.

The anodic coating developed by Bengough and Sutton[2] has proved one of the most satisfactory coatings from the standpoint of corrosion resistance and has probably had more extensive commercial use than any other. The electrolyte consists of a 3% solution of chromic acid, and it is regarded as necessary to keep the chlorine content equivalent to less than 0.2 g./l. NaCl and the sulphate content equivalent to less than 0.5 g./l. H_2SO_4. Specimens to be coated

* Publication approved by the Director of the National Bureau of Standards.
** Junior Metallurgist, Bureau of Standards.

Aluminum Alloys*

MUTCHLER**

(On facing page) Ford tri-motor plane with wings and fuselage covered with corrugated "Alclad" sheet. All interior structural work made from 17ST sheet. (Above) Another view of a Ford tri-motor ship, showing fuselage and wings covered with "Alclad" sheet.

are first cleaned free from grease with some solvent such as naphtha and are then washed in hot water.

The acid solution is frequently placed in a steel container, since the latter can serve also as the cathode. The recommended procedure is to control the bath voltage as to raise it gradually from 0 to 40 volts within 15 minutes, hold it at 40 volts for 35 minutes raise it to 50 volts within 5 minutes, and hold it at 50 volts for 5 minutes. The temperature of the bath should be held constant at 40° C., for the temperature apparently is a determining factor in the production of corrosion resistant films.

The Bengough process is applicable to the majority of the aluminum alloys. Copper in excess of 5% has a deleterious effect on the corrosion resistance, since the compound $CuAl_2$ is attacked more rapidly than the remainder of the surface, and gives rise to discontinuities in the film. The coatings obtained on the wrought alloys are usually more corrosion resistant than those on cast alloys. The films cannot be applied if the aluminum alloys are in contact with dissimilar metals, but good welds apparently offer no particular difficulties.[3]

Analyses have indicated that the oxide film contains chromium compounds equivalent to about 0.04 gram of CrO_3 per square meter, and the corrosion resistance of the film is attributed in part to their presence.[4] It has been estimated that the film is about 100 times as thick as that which forms naturally on aluminum. The metal undergoes a slight loss in weight in the coating process. The color of the film varies somewhat with the alloy treated. On alloys of the 17S type it is usually a pleasing greenish-gray; high silicon alloys yield a dull purple film.

In corrosion resistance the films produced by the chromic acid anodization have proved to be among the best of the oxide films. The films will retard the onset of corrosive attack under severe corrosive conditions for an appreciable, although relatively short, period. Under mild conditions of service, it will afford protection comparable with, and often better than, that of many paints. The capacity of the films for absorbing dyes such as alizarine orange or yellow, anthracene blue and Solvay green, is excellent, and makes it possible to obtain a variety of decorative effects.

Commentz[5] was among the first to recommend a cold concentrated sulphuric acid electrolyte for the production of a "strong coating." A process of anodization commercially known as "Alumilite"[6] is reported to employ a solution containing about 25% by weight of sulphuric acid. A 6% antimonial lead alloy serves as the cathode. Anodization is accomplished by applying from 12 to 15 volts, at temperatures ranging from 20° to 30° C., for periods of from 10 to 40 minutes. The "Alumilite" oxide film has been used principally for decorative purposes. The film absorbs both paints and dyes and over 60 shades of colors are said to be available. The "Alumilite" film offers unusually good resistance to abrasion and is reputed to have a Bierbaum scratch hardness value equivalent to that of a medium hard steel. Its corrosion resistance is comparable with that of the oxide film obtained by the Bengough process.

The Stafford-O'Brien[7] and Gower-O'Brien[8] anodization processes, which have been used commercially in Europe to some extent for purposes of protection, also employ an electrolyte of sulphuric acid. In addition to the acid the Stafford-O'Brien solution contains a chloride while the Gower-O'Brien solution utilizes other salts such as sodium dichromate and sodium hyposulphite. Rackwitz reports that aluminum alloys anodized by the latter method have been used successfully aboard ships. The Stafford-O'Brien process is reported to produce satisfactory films on aluminum alloys containing more than 5% of copper.

The anodization processes just reviewed are among the best so far developed for the production of corrosion resistant films. Other electrolytes may be used to obtain oxide films, among them sodium hydrogen phosphate,[9] borax,[10] sodium oxalate,[11] fused sodium nitrate, ammonium hydroxide and ammonium sulphide.[12] Experience has indicated, however, that these films are inferior to the above-mentioned coatings in their corrosion resistance, although they may be utilized for purposes of decoration or insulation.

It has already been stated that it is possible to produce oxide films on aluminum alloys by simple immersion in suitable solutions. Dilute solutions of nitric

acid, phosphoric acid or sodium hydroxide may be used and, although the resulting films are resistant to only very mild corrosive conditions, they can be used with considerable success to obtain good adherence of paint or varnish coatings.

A method developed by Jirotka[13] consists in immersing the specimens in a solution of chromates or dichromates and one or more salts of a heavy metal (usually carbonates). The treatment is usually carried out in enameled vessels at temperatures slightly below boiling and for periods from a few minutes to an hour or more. The compositions of the Jirotka baths, of which there are more than 80, show rather wide variations. A typical solution which produces a film somewhat resembling in appearance that obtained by the Bengough process contains 5 g./l. chromium sulphate, 25 g./l. potassium carbonate, 25 g./l. sodium bicarbonate and 5 g./l. potassium dichromate. The Jirotka films have been used to a considerable extent commercially, principally for decoration and finishes resembling copper, bronze, gold, silver and nickel, are readily obtained. The plain films are more corrosion-resistant under mild conditions than those produced by most other immersion methods. They are thinner than films obtained by electrolytic methods, although they show fair resistance to abrasion.

McCulloch[14] has recently developed a method which yields dead-white coatings on aluminum and dull gray coatings on its alloys. The method consists in immersion of specimens in a boiling solution containing 10 grams of unslaked lime and 10 grams of hydrated calcium sulphate per liter. The coatings are comparable in their corrosion resistance to those obtained by the Jirotka method but are less resistant to abrasion and can be rubbed off with a pencil eraser.

METALLIC COATINGS

Recent experiments by Akimow[15] have indicated that the metals best suited for the protection of aluminum alloys under saline conditions are zinc, aluminum, cadmium, magnesium and manganese. This Russian investigator measured the potential differences set up in dilute solutions of sodium chloride with and without additions of hydrogen peroxide. Of the above metals, zinc, aluminum and cadmium appear to be the only ones capable of practical application.

The methods of obtaining metallic coatings on aluminum alloys include electrodeposition, metal spraying and integral alloying with the base metal. The use of metallic coatings other than aluminum or an alloy of similar density may not always be feasible in aircraft because of weight considerations.

Aluminum alloys have been electroplated with a number of metals since Work[16] performed his extensive work in developing suitable methods of plating. With the possible exceptions of zinc and cadmium coatings, however, electrodeposited coatings have generally failed to give satisfactory protection under severe corrosive conditions. Many deposits which have an excellent superficial appearance when new, exhibit a tendency to blister and peel after short periods of service in the presence of moisture, which difficulty has been traced to discontinuities such as "pin-holes" in the coatings.[17]

Cournot[18] and Cazaud[19] have developed a method termed "cementation" in which aluminum alloys are first plated with relatively thick copper deposits and are then heated to temperatures of 545° to 620° C. in a neutral atmosphere. The treatment results in an adherent alloyed coating. Almost any finish can be secured by plating other metals over the copper. Quite aside from any detrimental effect that the somewhat drastic heat-treatment may have, weight considerations might limit the utilization of coatings of this type in aircraft.

The commercial applications of electrodeposited metallic coatings, with or without subsequent "cementation," seem to be limited, for the most part, to the production of decorative effects. Electrodeposition of aluminum, the most desirable coating, is not yet practicable. Protection from corrosive attack is restricted to conditions of mild exposure except for coatings such as zinc and cadmium. Coatings of nickel, copper or chromium are not satisfactory because they are or become porous and the resulting electrolytic action accelerates the attack of the base metal.

What has been said of electrodeposited coatings applies, in general, to metal-sprayed[20] coatings on aluminum alloys. Coatings of aluminum or zinc sprayed by the Schoop process afford excellent protection for relatively long periods under severe saline conditions. Zinc coatings, however, are not satisfactory in sulphurous atmospheres.

Patented Aluminum Tank Truck Body.

Alloying of the base metal and the coating does not occur in the metal spray process, the sprayed metal being "linked" entirely mechanically to the surface. For this reason a preliminary surface roughening, as by sand-blasting, is essential for good adherence. Sand-blasting of sheet material frequently results in a lowering of the tensile properties of the metal and heat treatment is necessary to restore them to their original values. The excellent protection afforded by sprayed aluminum coatings makes their use commercially feasible. Consideration of the theoretical potentials involved has led to the application of metallic coatings, by alloying them directly upon the base metal. The degree of protection thus afforded is vastly superior to that of coatings produced by any other method with the possible exception of sprayed metal.

An alloy sheet marketed under the trade-mark "Alclad"[21] is now manufactured in America. It con-

sists of an aluminum alloy (usually 17S), to both sides of which a layer of very pure aluminum is alloyed. The thickness of the aluminum layer on each side averages about 5% of the total thickness of the sheet. In the heat treated condition, the tensile strength and yield point of the coated sheet are from 5 to 10% lower than those obtained on sheet of the same gage composed entirely of duralumin. Elongation values are the same for both. The superior corrosion resistance, however, more than compensates for the slight lowering in strength where the latter is not essential.

The layer of aluminum is quite resistant to damage. When such does occur, however, the potential difference set up in the presence of moisture favors attack on the aluminum coating and the base metal remains unattacked even though relatively large areas, for example, 1/4 inch in diameter, are exposed. So long as the attack is confined to the coating, the material suffers no appreciable loss in tensile properties. The corrosion-resistance of Alclad sheet is exceptionally good under conditions of repeated flexural stress, which is an evidence that the adherence of the aluminum coating is much superior to that of other coatings.

In Germany there is manufactured an alloy termed Allautal, in which the Lautal alloy is fabricated with an integrally alloyed surface layer of pure aluminum as in the case of Alclad sheet. Another German product known as Duralplat[22] consists of duralumin similarly coated with a copper-free aluminum alloy. Duralplat was developed on the theory that if the potential difference between the surface coating and the base metal was less than that between pure aluminum and the base metal, the attack on the surface layer would proceed more slowly. Duralplat is reported to offer corrosion resistance as good as, if not better than Alclad sheet, although no definite data have yet appeared in the literature.

Aluminum Office Chair Finished to Resemble Wood with Polished Aluminum Strips on Legs.

ORGANIC COATINGS

Paints, varnishes, greases, etc., have been used extensively for both decoration and protection for many years. Their ease of application by simple brushing, spraying or dipping, necessitates the use of comparatively little equipment, and adds to their desirability. On the other hand, most coatings of this type are permeable in some degree to moisture which may react with the base metal and lessen the adhesion of the coating. They are also susceptible to deterioration by sunlight and weather. The relative inability of the coatings to withstand mechanical injury is also detrimental.

Such coatings afford practically unlimited scope for decorative effects and a certain degree of protection under rather mild corrosive conditions. Where protection is the paramount object, a coating must be selected that is adapted to the particular conditions under which it is to be used in service.

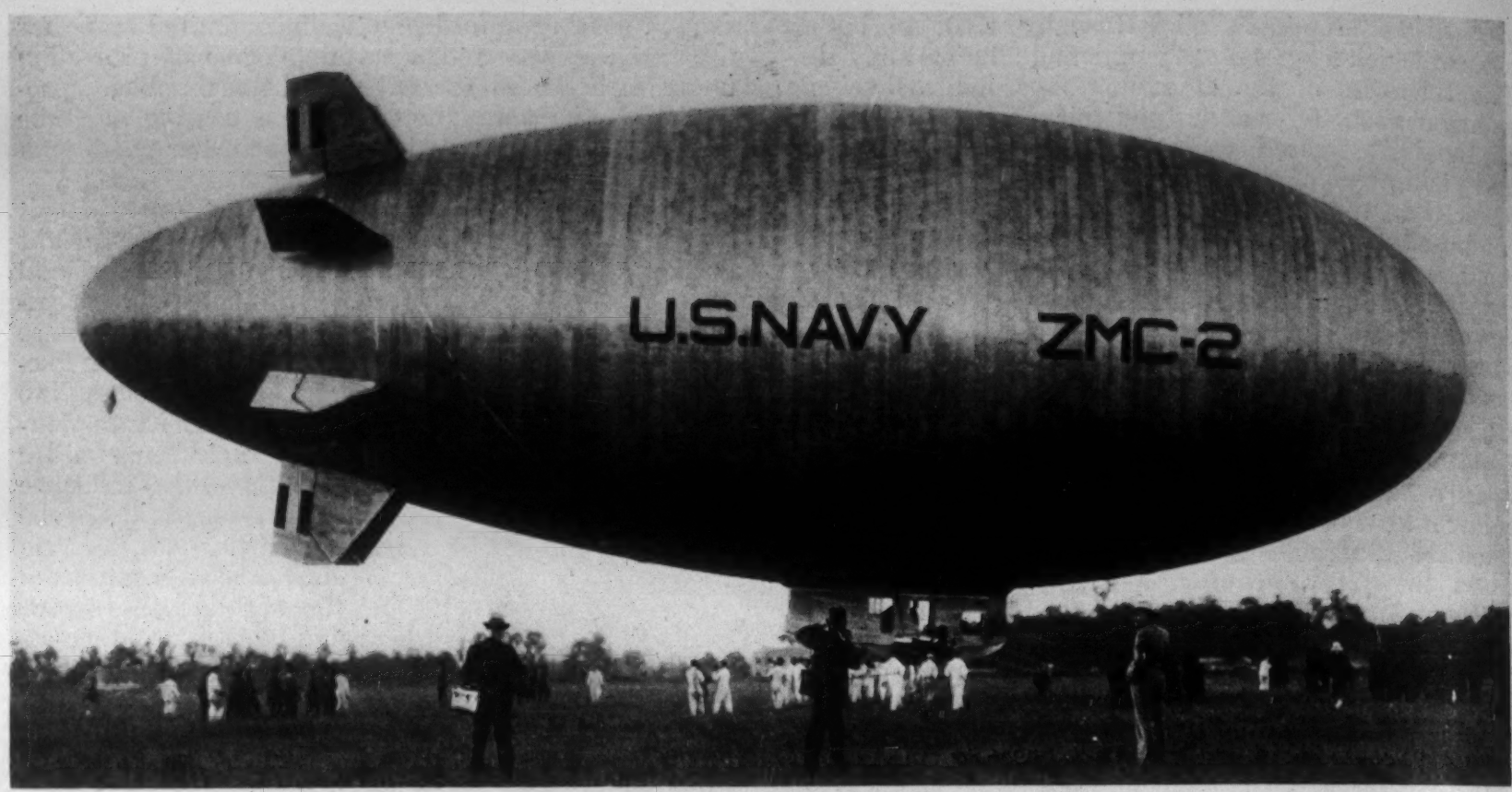
The requirements for coatings on aircraft are difficult to fulfill in the case of paints or varnishes. Low weight per unit of area is, of course, a prime requisite. Good elastic properties which foster continuous and permanent surface adherence under vibration, are likewise essential. Add to these the ability to withstand rapid temperature variations, the influence of ultra-violet rays in the higher altitudes, climatic conditions ranging from the frigid to the torrid, and moisture contacts as severe as salt spray or seawater, and the difficulties in selecting suitable organic protective coatings become apparent.

The adherence of paint to an untreated duralumin alloy surface, immersed from time to time in water, is usually poor, and hence preliminary treatment of the surface is imperative and may be as important as the selection of the paint. Mechanical roughening, by means of sand blasting or scratch brushing, has proved inferior to mild chemical treatment. Mere removal of grease from an unroughened surface by solvents such as benzene is not very effective, since paints applied to surfaces of this type tend to develop "blisters" in the presence of moisture. The blisters contain both water and gas, the latter exerting a pressure which tends to enlarge the blisters and to strip the paint from the surface.

When protection against corrosion is the paramount object, primers should be chosen with that end in view. "Red oxide," zinc chromate, and mixtures of zinc chromate and bituminous paint, and aluminum-pigmented spar varnish have been shown by experience to be among the best. The application of 2 additional coats of paint, rather than only one, is also to be recommended wherever possible.

Only a few organic coatings remain stable for long periods under severe corrosive conditions. Certain bituminous or asphaltum paints are quite impervious to moisture, possess excellent adhesive qualities, afford good protection, and have been used with success on parts submerged continuously in salt water. These paints are prepared with coal-tar solvents, such as naphtha or benzene. Their chief disadvantage is their susceptibility to damage by abrasion and their lack of resistance to sunlight.

It has been found that the addition of pure aluminum bronze powder, about 140 mesh, to suitable paints



The all-metal airship ZMC-2, built by the Aircraft Development Corporation, has an internal frame made from aluminum alloy sheet and tubing. The entire gas bag is enclosed in a shell of .0095 inch "Alclad" sheet.

and varnishes markedly increases their imperviousness to moisture. The powder is composed of minute flakes and tends to form a thin, practically continuous film of aluminum at the surface of the vehicle. Good grades of long oil varnish are made especially as vehicles for aluminum powder, and the resultant paint has proved durable and efficient under severe conditions of exposure.

Edwards and Wray[23] have shown that the moisture-proofing efficiencies of unpigmented long oil varnishes, which average about 60% in three coats can be raised to as high as 96% by pigmenting with aluminum powder. Aluminum pigmented bituminous paints also have moisture-proofing efficiency values of about 98%. Aluminum pigmented coatings exhibit a high degree of opacity and reflectivity, the former being of considerable importance in that it prevents the transmission of ultra-violet rays and thus adds measurably to the protective qualities and life of the vehicle.

Enamels which do not require "baking" have been used for purposes of protection, and good results have been obtained with 2 coats of Navy gray enamel on a red oxide primer. Coatings which require baking are not to be recommended, since heating at temperatures in excess of 100° C. frequently renders aluminum alloys, especially when in sheet form, more susceptible to corrosion. For castings not subjected to vibratory stresses, immersion in an aqueous sodium silicate solution[24] having a specific gravity of 1.1, followed by baking at 120–175° C., has afforded good protection under mild conditions and gives a coating to which paints adhere well.

COMBINATIONS OF COATINGS

The ability of certain oxide films to absorb paint vehicle, varnish and grease has made it possible to obtain combinations which render very satisfactory service under severe conditions of exposure. The resistance of the absorbed coatings to hygroscopic action is increased many-fold; blisters, when formed, remain comparatively small in size, as the adherence between the oxide film and the paint is usually sufficient to counteract the spreading or stripping tendencies already noted. It should be stated, however, that the best of such combinations of coatings has not yet resulted in the same degree of protection attainable with coatings of the Alclad sheet type.

The Bengough oxide film is particularly suited for the application of paint, varnish and grease. Films produced by the Jirotka method likewise form a very good base for organic coatings, but are somewhat inferior to the Bengough films in this respect. Milburn[25] has pointed out that excellent protection may be obtained on aluminum alloys exposed continuously to salt water by first anodizing, painting with an aluminum-pigmented vehicle, and then applying an additional coat of beeswax mixed with grease. It is also possible to use combination coatings with alloys of the Alclad sheet and Duralplat types Excellent protection for prolonged periods is to be expected if, for example, an Alclad sheet specimen is treated anodically and then painted or greased.

A series of weather-exposure tests is now being conducted by the Bureau of Standards to obtain data on the efficiency of various protective coatings. Some of the specimens are suspended from the side of a pier at Hampton Roads, Va. and are about 3 feet above the sea-water at high tide. The specimens are, therefore, exposed to temperate sea-coastal atmospheric conditions with an occasional wetting by sea water. The specimens shown in Figs. 1 and 2 form a part of these tests. Six of the specimens (a-f) were exposed for a period of 3 years and specimen (g) was exposed for $3^1/_2$ years.

The specimens shown in the figures were all 14-gage (0.064 inch thick) sheet duralumin material. With the exception of specimen (*a*), which was quenched in ice water, the specimens were quenched in boiling water from temperatures of 500–510° C. The individual specimens were given surface treatments, prior to exposure, as follows: (*a*) none; (*b*) none; (*c*) Jirotka immersion followed by a dip in a solution of lanoline in benzene; (*d*) Bengough anodization and lanoline dip as in (*c*); (*e*) cleaned free from grease with ben-

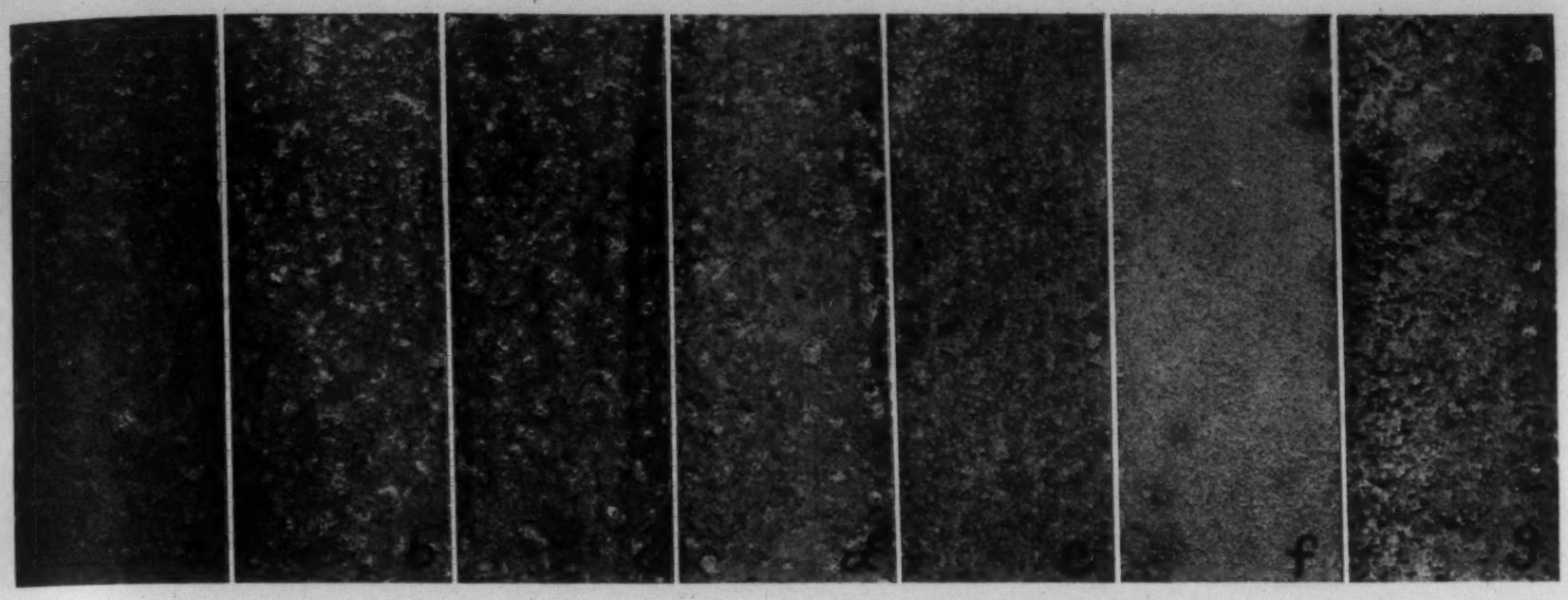


Fig. 1. Surface appearance of Duralumin specimens given various coatings, after exposure for approximately 3 years to the weather at Hampton Roads, Va. The surface treatments were as follows: (a) and (b) none;—(c) Jirotka + grease (d) Bengough anodization + grease; (e) aluminum pigmented spar varnish; (f) Bengough anodization + aluminum pigmented spar varnish; (g) Alclad material. $1^1/_3\times$.

zene and given three coats of aluminum pigmented spar varnish; (*f*) Bengough anodization plus 3 coats of varnish as in (*e*); (*g*) Alclad sheet. Specimens (*a*) and (*b*) are included to illustrate the tremendous effect which heat treatment may have in determining whether or not the corrosive attack will be intra- or inter-crystalline in nature. The heat treatment plays a definite rôle in the production of corrosion resistant material and quenching should always be carried out in *cold* water. Specimens (*c*) to (*g*), inclusive, were purposely quenched in boiling water so that corrosion of the intercrystalline type would occur immediately following coating "breakdown;" the presence of this type of attack produces a noticeable loss in tensile properties.

It may be seen in Fig. 1 that at the end of the 3 year exposure period there was no marked difference in the surface appearance of specimens (*a*), (*b*), (*c*) and (*d*). Specimen (*e*) was obviously less severely attacked than any of the former, but the paint coating had completely weathered away. On specimen (*f*) the coating had commenced to show first evidences of "breakdown" but was still practically unattacked, thus illustrating the benefit to be derived from prior anodic treatment when applying paints. The surface appearance of specimen (*g*) indicated the presence of corrosive attack. The surface appearance of Alclad sheet does not, however, serve as a very reliable criterion of the extent or depth of penetration of corrosive attack because the pure aluminum layer itself may be severely attacked while the duralumin base remains unattacked.

The appearance of the specimens under the microscope is shown in Fig. 2. Note the decided difference in both the type and depth of penetration of corrosive attack in specimens (*a*) and (*b*). That the oxide film-grease combinations retarded the initial corrosive attack for an appreciable period is evident from (*c*) and (*d*). The aluminum pigmented spar varnish on the unanodized surface of specimen (*e*) afforded protection comparable with that of the oxide-grease combinations. The protection afforded by the paint applied to the anodized surface of specimen (*f*) was vastly superior and corrosion had just begun after 3 years' exposure. The corrosive attack on specimen (*g*) was entirely confined to the aluminum coating, which had not yet been penetrated through.

The tensile properties serve as approximate criteria of the damage done by corrosion. Before the exposure tests specimens (*a*) to (*e*), inclusive, had an ultimate tensile strength of approximately 60,000 lbs./in.^{2} and an elongation in 2 inches of about 20%. In general, the loss in tensile strength due to corrosion was approximately 10% and that in elongation was more than 50%. No appreciable loss in tensile strength and a small reduction in elongation was noted for specimen (*f*). The elongation before exposure of specimen (*g*) was also 20% and its strength was approximately 56,000 lbs./in.^{2} It is especially significant that after over 3 years' exposure only the Alclad sheet showed no loss whatever in tensile properties.

CONCLUSIONS

The development of decorative and protective coatings for aluminum alloys has kept pace with the development of the alloys themselves. The number of

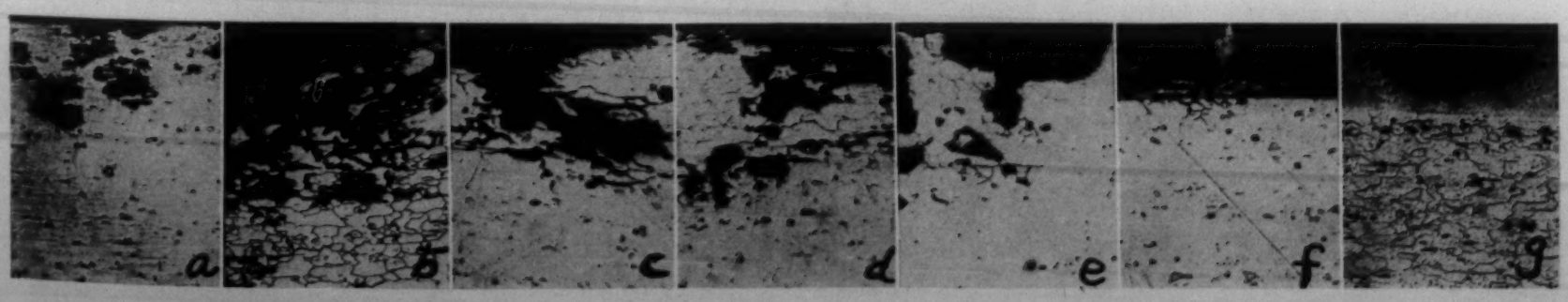
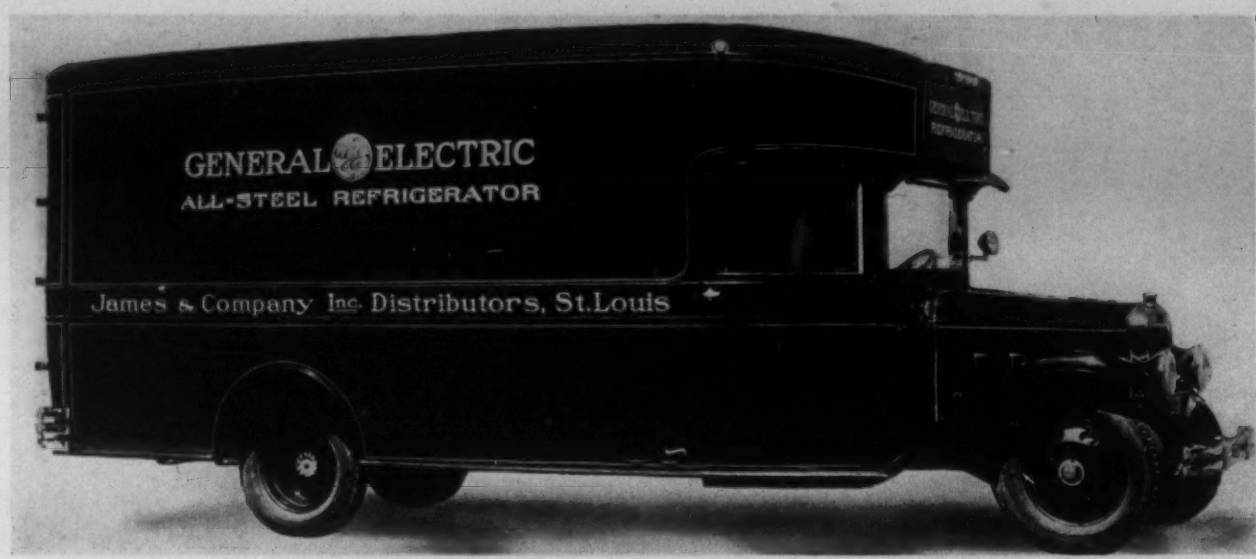


Fig. 2. Microstructure of cross-sections of specimens shown in Fig. 1. Specimens (a)—(f) are in unetched condition. Specimen (g) was etched to differentiate the pure aluminum coating from the base metal; the corrosve attack has not penetrated the coating. (Originally photographed at 250× and subsequently reduced to 100×.)



Aluminum Van Body Painted.

methods of coating available make it possible to exercise considerable choice in selecting the most satisfactory coating for the desired service. For purposes of corrosion prevention, in particular, many coatings afford sufficient protection for mild conditions of exposure. For severe conditions of exposure, the choice of protective coatings becomes more limited. Specially fabricated materials of the Alclad sheet or Duralplat types, however, assure protection for relatively long periods under severe corrosive conditions. Where their use is impracticable, suitable paint coatings, applied to previously anodized surfaces, afford excellent protection for shorter periods.

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Samuel Frankel, formerly Chief Metallurgist and Director of Sales of the Niagara Falls Smelting & Refining Corporation of Buffalo, New York, has been appointed Director of Sales, Special Alloys Department, Federated Metals Corporation, Newark, N. J.

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The Duriron Company, Inc. of Dayton, Ohio, has appointed **H. P. Rodgers** as their representative for the Cleveland territory. Offices are located at 528 Leader Building.

Shwinigan Chemical Co., Ltd., Montreal, Canada, has been licensed by the Duriron Company, Dayton, Ohio, to produce Duriron and Duriron equipment for all of Canada and Newfoundland. This is the first instance of a foreign company being granted a manufacturing license for Duriron.

Aluminum Van Body Painted.

Plated cast-iron door knobs lacquered with the same lacquer. The knob on the left shows considerable stain spotting due largely to insufficient cleaning. The other was well cleaned prior to lacquering, and shows practically no failure.

Evaluation of Clear Nitrocellulose METAL LACQUERS

BY G. C. SHAKOUR AND L. W. MUNCHMEYER*

THERE are several well-known types of lacquers for metal protection. This article describes the qualities of four types and tells how nitrocellulose lacquers, the most important member of the group, can be tested and evaluated.

CLEAR metal lacquers are applied to metals as a protective or ornamental finish and have been an industrial commodity for many years. Since the metal working art has achieved such popularity in the household field, the uses for clear metal lacquers have increased immensely. Now the major part of the products of the builder's hardware, lighting fixtures and metal novelty industries, as well as many other miscellaneous metal articles, are coated with clear metal lacquers.

It is obvious that with this increasing demand for clear metal lacquers that various types of products will be found and developed to meet the particular requirements as they arise. The most important types of clear metal lacquers and their variations being used by the industries are:

I. Lacquers Manufactured from Phenol Condensation Products (Bakelite).
II. Lacquers Manufactured from Condensation Products of Polyhydric Alcohols and Polybasic Acids and Their Modifications (Glyptals and Resyls).
III. Gum Lacquers (Water Dip Lacquers).
IV. Nitrocellulose Lacquers.
  (a) General Purpose Lacquers.
  (b) Silver Lacquer.
  (c) Special Products.

Lacquers Manufactured from Phenol Condensation Products

Lacquers manufactured from phenol condensation products are best adapted for use where a very hard, durable, protective coating is required, and which is unaffected by alcohols, alkalies and acids in common use. However, there are some disadvantages to this type of lacquer. Among these are, pronounced yellowing of film on aging or exposure to sunlight, discoloration of some work due to chemical reaction between the wet lacquer and the metal being coated, difficulty of application and special equipment for handling.

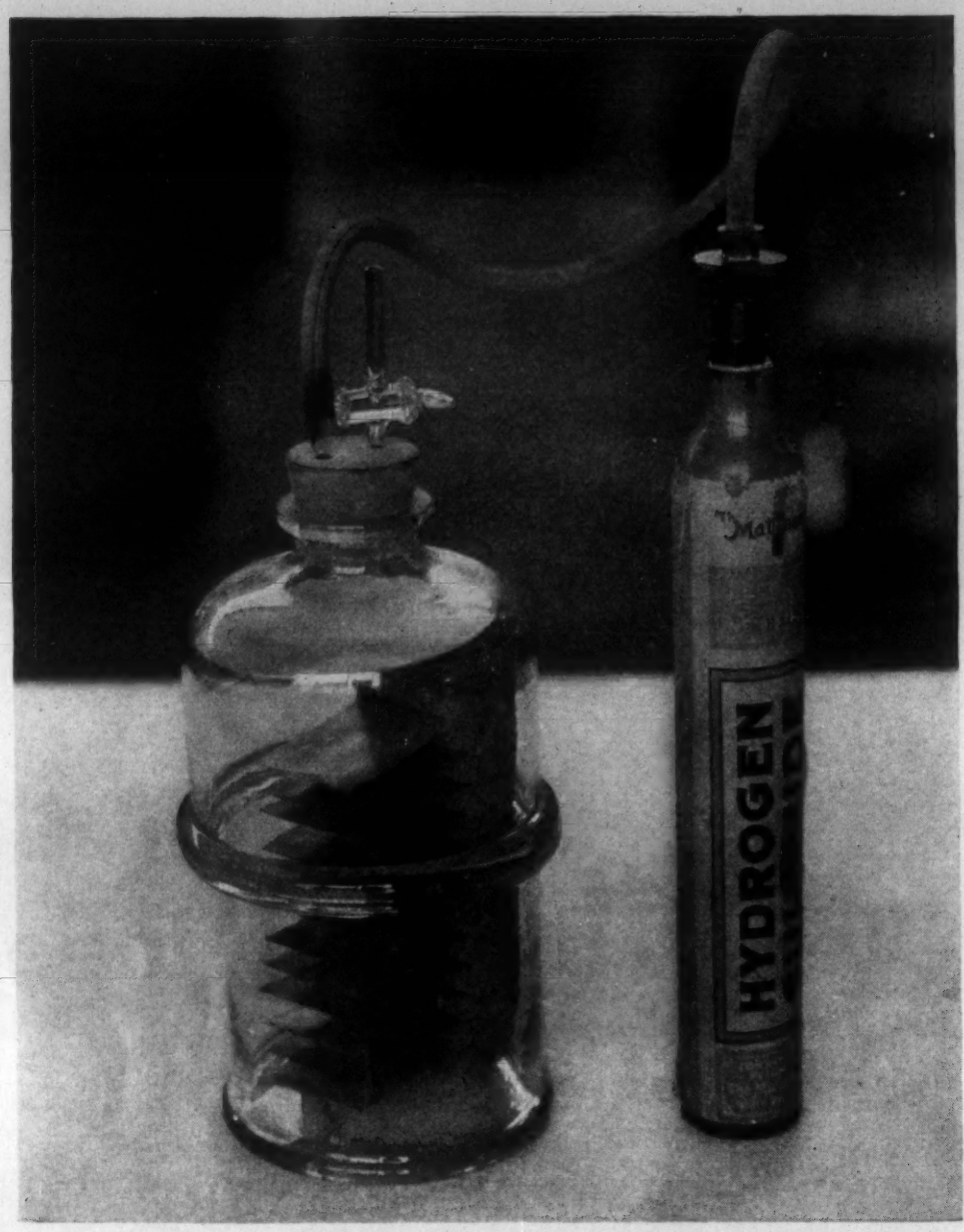
Lacquers Manufactured from Condensation Products of Polyhydric Alcohols and Polybasic Acids and Their Modifications (Glyptals and Resyls)

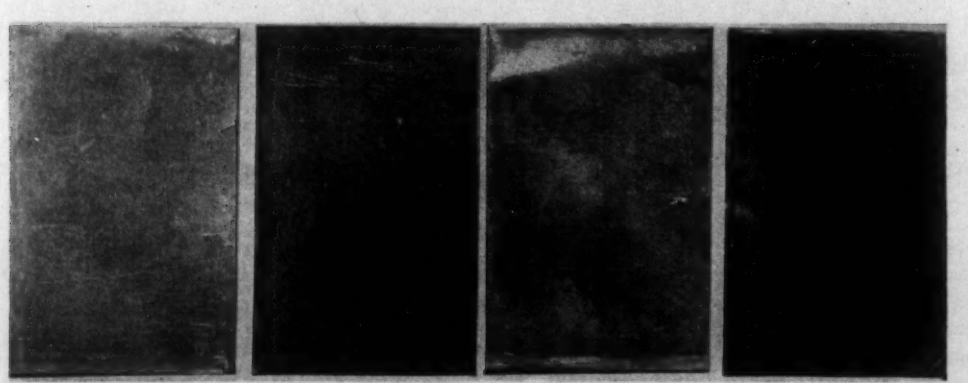
This type of clear metal lacquer is used in place of nitrocellulose lacquers where greater durability, wear resistance and flexibility is required. Most lacquers of this type, however, like the phenol condensation products have a greater tendency to yellow and are generally darker in color than most well-balanced, high grade nitrocellulose lacquers. They are also more difficult to apply and require a longer drying period.

Gum Lacquers

Gum lacquers are the most inexpensive type of the entire group of clear metal lacquers of commercial importance to-day and are characterized by their lack of durability. They are used chiefly in coating inexpensive metal articles to prevent tarnishing and corroding of the articles until they are sold to the ultimate consumer. This type of lacquer is suitable for coating dry or water wet metal articles.

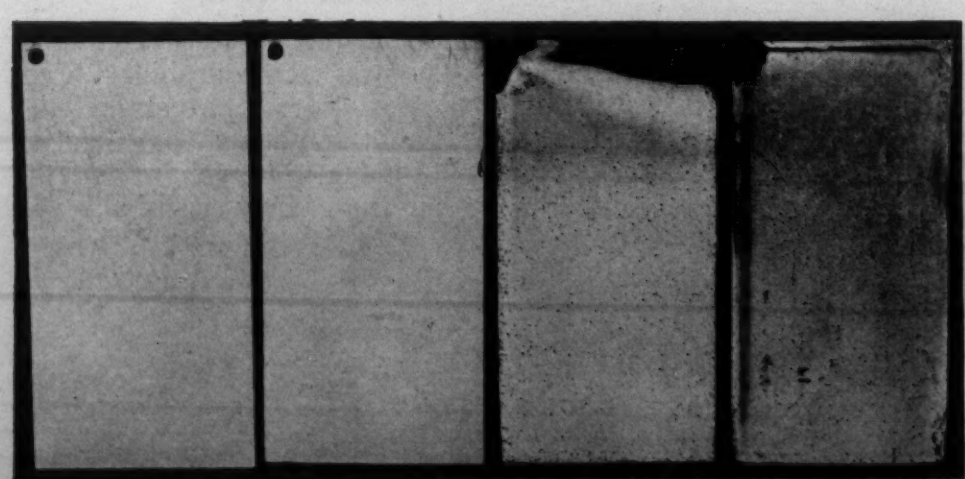
* E. I. du Pont de Nemours & Co., Inc., Parlin, New Jersey.





Lacquer (a) Lacquer (b) Lacquer (c) Lacquer (d)

Apparatus used by du Pont Laboratories for conducting hydrogen sulphide test, and lacquered panels subjected to this test, showing wide difference in permeability of films.



(a) Unexposed panel. (b) Yellowing of film. (c) Corrosion with slight discoloration. (d) Corrosion with marked discoloration.

Failure on Outdoor Exposure.

Nitrocellulose (Cellulose Nitrate) Clear Metal Lacquers

Nitrocellulose lacquers are commercially the most important member of the group in the field of clear metal lacquers, and are used almost entirely for coating the more expensive metal goods. This class designates lacquers that usually contain appreciable proportions of natural or synthetic gums in addition to the nitrocellulose. High grade clear nitrocellulose metal lacquers are easy to apply, resistant to yellowing and non-corrosive. They have, however, less durability if the article is to be subjected to outdoor exposure, and less wear resistance than lacquers manufactured from phenol condensation products and also from condensation products of polyhydric alcohols and polybasic acids.

In view of the commercial significance of nitrocellulose lacquers in the clear metal lacquer field, we shall pass over the other members of the group without further comment and present the most important properties of nitrocellulose metal lacquers and a system of tests which will enable the consumer of these commodities to select a high-grade product which is best adapted for his work.

The most important properties of nitrocellulose clear metal lacquers are as follows:

1. Minimum crystal spotting under the lacquer film on oxidized finishes.
2. Minimum stain spotting under the lacquer film on cast work.
3. Maximum resistance to the deteriorating effect of outdoor exposure.
4. Maximum adhesion to the metal.
5. Maximum hardness without sacrifice of flexibility.
6. Maximum flexibility.
7. Minimum discoloration of film on aging.
8. Maximum tarnish resistance (green drip).
9. Perspiration resistance.

DESIRABLE PROPERTIES OF A METAL LACQUER

Minimum Crystal Spotting under the Lacquer Film on Oxidized Finishes

Crystal spotting is a type of failure that occurs only on the surface of metals having a sulphide film (generally referred to as oxidized finishes) and a coating of lacquer or similar material. The spots are formed by the permeation of the coating by volatile sulphur compounds which react with the metal to form brown or black crystals of cuprous sulphide. The photomicrograph shows the typical appearance of crystal spotting on oxidized finishes.

Hydrogen Sulphide Test:

The Principle of Test—Research work has shown that the degree of susceptibility of the lacquer film to the penetration of the volatile sulphur compounds can be determined by the rate at which hydrogen sulphide (H_2S) gas permeates through the lacquer film. Hydrogen sulphide gas and other volatile sulphur compounds have a great affinity for activated copper and react with it to form black copper sulphide. If copper panels are coated with various lacquers and subjected to the gas, the degree of protection given the copper (represented by the bright-

ness of the panel shortly after exposure to the gas) affords a measure of the impermeability of a lacquer film relative to another.

Methods of Test—Soft rolled copper plates are heated to red heat in an oxidizing flame and reduced by immersing the plates in alcohol. After cooling (approximately one minute) the plates are removed from the alcohol and wiped dry to obtain a bright copper surface. Two bright copper plates are dipped in each of the lacquers under test, air-dried for $^1/_2$ hour and baked for 15 minutes at 65° C. (149° F.). After drying, the plates coated with the various lacquers under test are exposed to an atmosphere of hydrogen sulphide under slight pressure. After 30 minutes' exposure, the plates are compared in brightness with a panel which had not been exposed to the gas. The least discolored panel indicates the greatest impermeability of the lacquer coating to hydrogen sulphide and other gaseous sulphur compounds.

Minimum Stain Spotting under the Lacquer Film on Cast Work

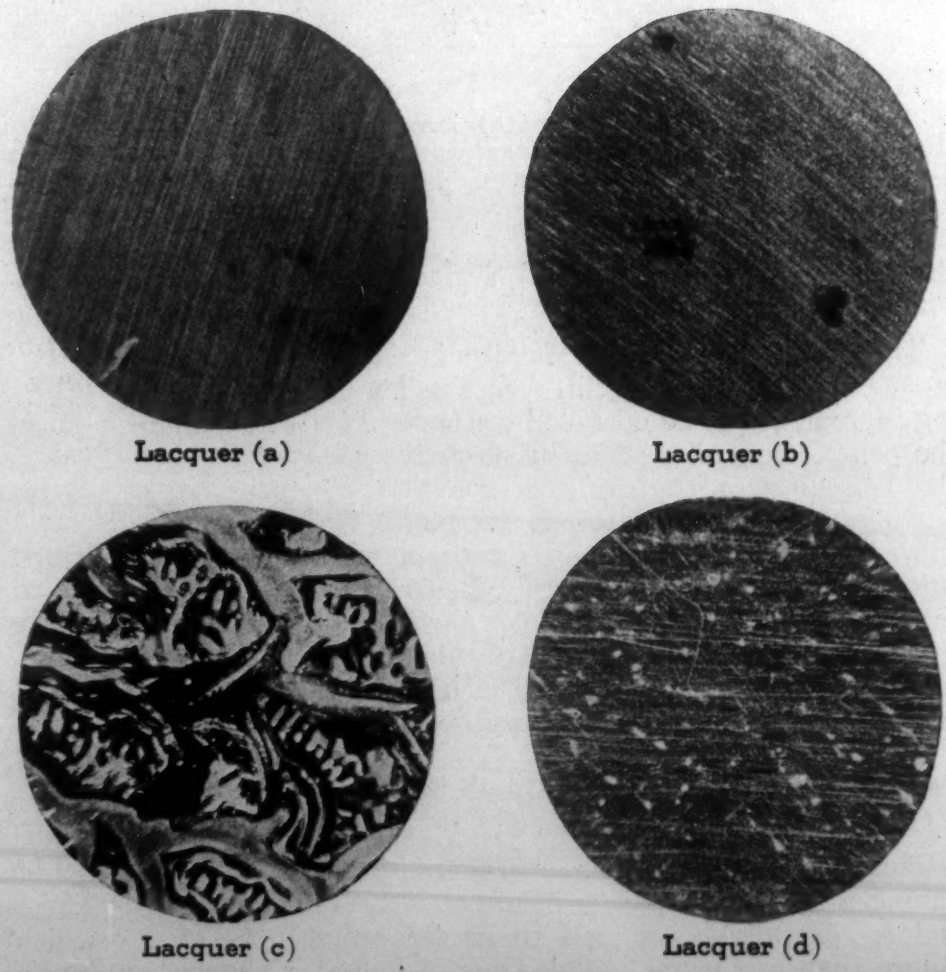
Stain spots are a type of failure that occur only on porous metals (usually cast work or work pitted by the cleaning solutions) which have been subjected to the action of cleaning, pickling or plating solutions. In preparing the metal prior to lacquering, part of the solutions become entrapped in the pores of the metal and on evaporation are left as dry, unreactive compounds. Upon subsequent exposure of the articles to a humid atmosphere, the deliquescent compounds in the pores of the metal are reactivated by moisture and exude from the pores, staining the metal. Stain spotting may occur either on oxidized or unoxidized, plated or unplated, lacquered or unlacquered metal. The photomicrograph shows the typical appearance of stain spotting on porous metal.

Test for Stain Spotting:

As lacquer films which are highly impermeable to water vapor, moist corrosive gases, and are resistant to alkaline chemical compounds have been found to have good resistance to stain spotting the rate of failure under these conditions has been set up as an index to stain spotting.

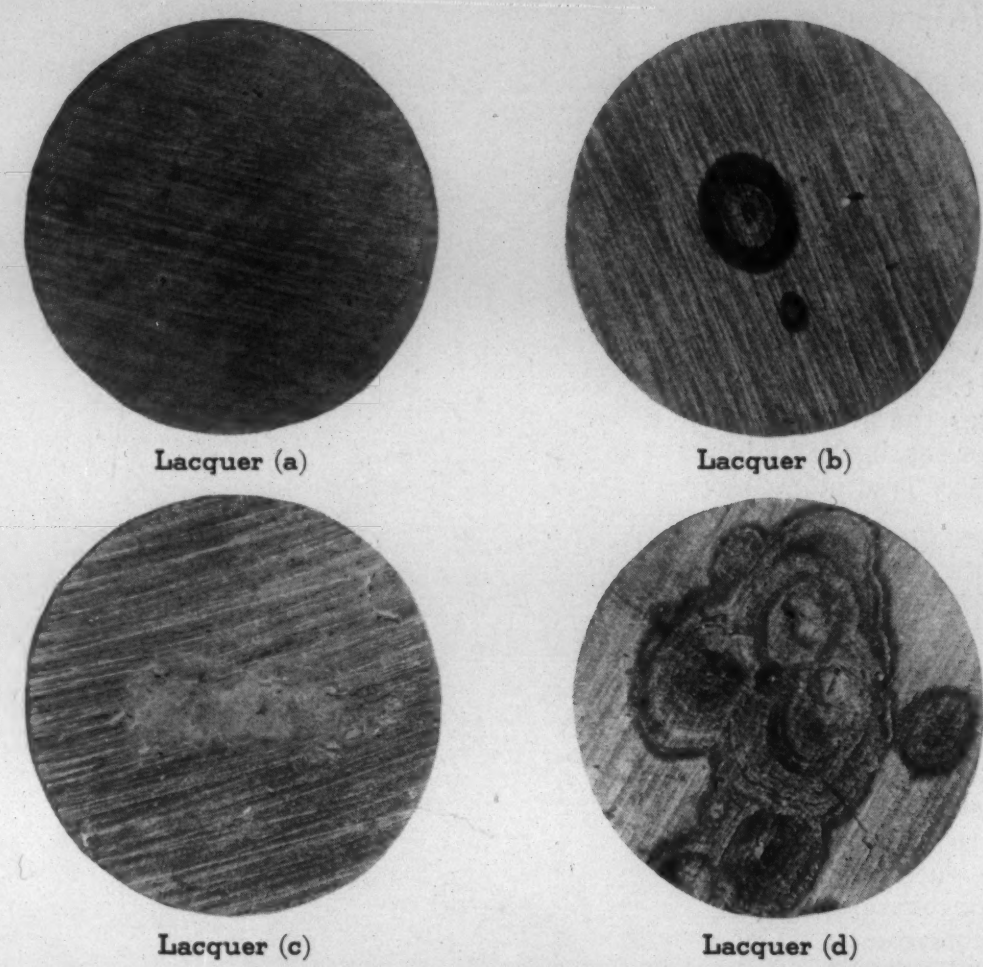
Method of Test—The test consists of suspending lacquered brass panels (same thickness of coating) over an oxidizing bath containing 9 parts of ammonium hydrosulphide (NH_4HS), 4 parts liver of sulphur and 435 parts of water, contained in a closed gas desiccator. An oxidizing bath such as that generally used in the plating industry will be quite satisfactory for use in this test. The test is run until some of the lacquers under test fail. Some lacquers fail in 20 minutes while others will stand the corrosive action of the moist vapor for several days. The length of time required for failure of the various lacquers under test is a measure of the impermeability of the lacquers to the corrosive action of the moist vapors and, therefore, is also a measure of the lacquer's resistance to stain spotting.

As can readily be seen from the photomicrographs shown above some very interesting data can be obtained concerning the mode of failure of the different



Oxidizing tank test apparatus developed by du Pont Laboratories, and lacquered panels subjected to this test.

lacquer films when subjected to this test. Though a microscopic study was made of these panels the mode of failure can easily be studied with the naked eye. The lacquers shown above are the same lacquers that were in the hydrogen sulphide test as well as in the other tests that will be illustrated. Panels (a), (b) and (d) were subjected to the Oxidizing Bath Test for 30 hours. Panel (c), which had withstood the dry Hydrogen Sulphide Test quite well, failed miserably in 15 minutes in this test.



Photomicrographs of brass panels lacquered with Lacquers (a), (b), (c) and (d) after having been subjected to the Salt Spray Test for 30 hours.

Maximum Resistance to the Deteriorating Effect of Outdoor Exposure

Durability on outdoor exposure is one of the most important properties of metal lacquers and is a true criterion of the protective power of any metal coating. Failure on outdoor exposure may result in either one of three ways described below and shown in the illustration:

First, Corrosion of the Metal Surface but Film Only Slightly Discolored.

This particular type of failure is characteristic of lacquers containing only nitrocellulose as the film forming ingredient. The corroded areas result either from the penetration of the film by corrosive gases or from the loosening or rupturing of the film by the dust particles of the air, leaving the metal exposed and subject to rapid corrosion. Lacquers which contain suitable resins have far greater adhesion and resistance to the abrasive action of dust particles. Panel (c) shown above represents failure of this type. Panel (a) represents a perfect panel and is used in this photograph only for comparative purposes.

Second, Corrosion of the Metal Surface and Film Greatly Discolored.

This type of failure is characteristic of lacquers having a poor combination of nitrocellulose and resins and is generally considered to be the worst type of failure than can result. This type of failure is shown distinctly by panel (d).

Third, Yellowing of Film.

It is a well-known fact that all nitrocellulose products have a slight tendency to yellow with age and that certain other lacquer ingredients tend to increase this yellowing. The lacquer technician can prevent the objectionable failures represented by panels (c) and (d). Slight yellowing, however, cannot be entirely eradicated but can be minimized by judicious formulation and very critical testing. Although slight yellowing must be classified as a failure, it is far less objectionable than the other two types since the metal is still fully protected and looks well. Panel (b) represents this type of failure.

Salt Spray Test:

The salt spray test, while it primarily serves as an indication of the resistance of lacquered metal to corrosion when subjected to salt vapor, proves also to be a further means of determining the impermeability of lacquer films to moisture. This test, therefore, offers to some extent a means of determining the relative resistance of lacquer films to the deteriorating effects of outdoor exposure.

Principle of Test—The rusting or corrosion of coated metal is due to moisture and air penetrating the coating. The use of a salt spray will show up these penetrations very quickly due to the corrosive action of salt water on metal. This must be considered as an accelerated test for a lacquer which must withstand exposure to high humidity at ordinary temperature, as well as for a lacquer that must withstand exposure to a salty atmosphere or to contact with salt water. The salt vapor thus provides a sensitive test for metal coatings subjected to these conditions and the amount of rusting or corroding occurring is an index of the relative results that would occur under such exposure in service.

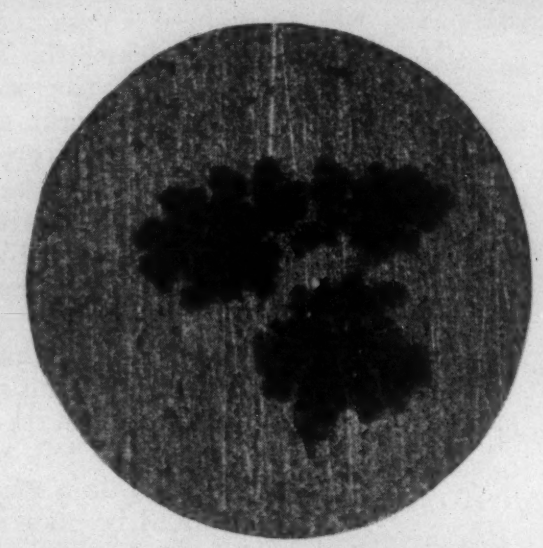
Method of Test—The material to be tested is applied to shiny brass plates (2″ × 4″) by spray or dip methods. After drying thoroughly, the plates are then placed in grooves of a wooden block which holds them in an upright position, and the entire block holding the plates is then placed in a salt spray cabinet. The spray consists of a 20% salt (NaCl) solution which is atomized by a 60-lb. air pressure. The relative position of the plates is of no importance because of the uniformity of the salt mist. The panels are examined every few hours (any convenient time interval) for failure of the lacquer coating by corrosion areas on the metal. The length of time required for failure and the extent of corrosion of the metal is a measure of the relative resistance of various lacquers under the established conditions of test.

Adhesion, Hardness and Flexibility

The properties of adhesion, hardness and flexibility are important properties of a metal lacquer. These properties are not entirely independent of each other as they might appear, but are to some extent related insofar as the factors governing any one of these properties have at least some effect on the other two.

Standard Knife Test for Adhesion and Hardness—The method consists of dipping (2″ × 4″ × .008″) brass plates in the thinned lacquers under test and then allowing the panels to air-dry for $^1/_2$ hour followed by a bake for 15 minutes at 60° C. (140° F.). After cooling, the film characteristics are tested by holding a scalpel on the surface of the film and at right angles to the direction of movement. The arm is drawn toward the body and with a slight pressure the lacquer film is cut in such a manner as to get between the film and the metal surface. In this way the hardness and adhesion of a lacquer may be determined and evaluated relative to another lacquer which is tested in parallel. The results of the knife test are affected greatly by the variable human factor, but with experience one is able to determine the relative hardness and adhesion of a lacquer better by this test than by most other methods of testing now in use.

Method of Testing for Flexibility—In testing for flexibility brass panels are prepared in the same manner as for testing for adhesion and hardness except that the panels are baked for $^1/_2$ hour instead of 15 minutes. After cooling, a panel is held between the thumb and index finger of both hands and is bent sharply upon itself (180°). The panel is again straightened and the operation is repeated 5 times. The lacquer film is then examined for flaking, which is an indication of lack of flexibility (not adhesion). A well-balanced lacquer, if prepared as mentioned previously, should show no flaking after bending five times. Baking excessively may cause flaking even with good lacquers.



Crystal spotting on oxidized finish.

Stain spotting on porous metal.

Discoloration of Film

Discoloration of lacquer films has already been discussed under the subject of durability.

Tarnish Resistance (Green Drip)

The chief concern of a lacquer consumer in respect to the acidity of a lacquer is to obtain a lacquer which will stand up well under all other tests and which will not form green drip (due to excessive acidity) on his work.

Method of Determining Acidity of Lacquers—Store bright strips of copper of the same surface area in contact with a definite quantity of each of the lacquers under test. The amount of discoloration (green) of any solution and the darkening of the copper strips may be taken as a measure of its acid content. The test should not be prolonged over 24 hours as results obtained beyond this time limit are of no value.

Perspiration Resistance

It has been observed that the coatings on parts of articles which are constantly handled wear through much faster than similar coatings which receive greater actual wear but which do not come in contact with perspiration. Coöperative tests conducted in conjunction with the Bell Telephone Laboratories reveal that nitrocellulose lacquer films subjected to the following test fail in the same order as did similar lacquers when subjected to practical tests conducted by the Bell Telephone Company.

Method of Test—The test consists of coating (dip or spray) any convenient size brass panels with the lacquers under test and drying the panels for 12 hours at 65° C. After this drying period, filter papers wet with oleic acid are placed on the lacquer films and the panels are then stored at 65° C. The number of hours it takes oleic acid to soften and wear through the lacquer films is taken as a measure of the resistance of the various lacquers to perspiration. It might be mentioned at this point that no nitrocellulose lacquer film has yet been found which has outstanding resistance to perspiration as well as being entirely satisfactory in all of the other important properties of metal lacquers.

THE SELECTION OF AN APPROPRIATE LACQUER

In selecting a lacquer which is best suited for finishing certain work, the lacquer consumer should make a careful analysis of the conditions to which his lacquered metal articles will be subjected and then select the tests which will tell him when he has a lacquer which will withstand those conditions. It is obvious that a general purpose metal lacquer, for instance, must rate high in all of the above mentioned tests. Certain silver lacquers might only need to be tested for adhesion, hardness and color, while still others might have to withstand more severe conditions and this will require a lacquer of the general purpose type. Occasionally metal lacquers will be required to meet certain unusual conditions. In such cases special lacquers are designed to fulfill these needs and the lacquers developed are classified as special products.

THE RATING OF NITROCELLULOSE METAL LACQUERS

The rating of nitrocellulose metal lacquers is probably the best way of selecting from a number of lacquers under consideration, the lacquer which will give the metal the greatest protection and keep it looking well for the longest period of time. It also provides an easily intelligible, permanent record of the results of tests on various lacquers.

In rating metal lacquers the properties may be divided into three groups: (*a*) ratable properties, (*b*) minimum requirements, (*c*) cost consideration. The properties put into group (*a*) are those considered of primary importance. Lacquer properties in this group

will be judged on a numerical rating basis. Properties placed in group (*b*) are considered of secondary importance. Lacquers must possess the properties in group (*b*) to a certain degree, which are considered as minimum requirements or be discarded as unfit for use.

Each property in group (*a*) is assigned a factor from 0 to 100 indicating the amount of importance attached to that particular property. The sum of these values should be 100. All lacquers will be rated in each of these properties on the basis of 0 to 10, and the rating should be multiplied by the importance factor. The sum of the products obtained will constitute the net rating of the lacquer. The properties of metal lacquers which should always be placed in group (*c*) are those which affect the unit finishing cost.

EXAMPLE

GROUP A	Importance Factor	Lacquer X	Product	Lacquer Y	Product
1. Resistance to Stain Spotting	15	9	135	6	90
2. Resistance to Crystal Spotting	10	8	80	8	80
3. Resistance to Effect of Outdoor Exposure	20	9	180	7	140
4. Resistance to Salt Vapor	12	5	60	5	60
5. Resistance to Discoloration of Film	18	7	126	5	90
6. Tarnish Resistance	10	6	60	6	60
7. Hardness	15	8	120	10	150
Net Rating			761		670

GROUP B—MINIMUM REQUIREMENTS

1. Adhesion
2. Color of Solution
3. Flow
4. Flexibility

GROUP C—COST CALCULATIONS

1. Blush Resistance
2. Percent Total Solids (Non-Volatile)
3. Thinner Tolerance

THE IMPORTANCE OF CLEANING OF METAL PRIOR TO LACQUERING

The selection and use of a high-grade metal lacquer will not always insure a successful finish, for the cleaning of metal is one of the most important, though often neglected phase in the lacquering of metal articles. The veracity of the statement that "for a trouble-proof finish start at the bottom" cannot be denied. The successful use of a high grade metal lacquer will depend directly upon the kind of cleaning the metal receives prior to the lacquering operation. Proper cleaning is the complete removal of all foreign matter from the surface and pores of the metal.

Although improper cleaning of metal prior to lacquering has a deleterious effect on all properties of a metal lacquer the properties of resistance to stain spotting, adhesion and hardness are most noticeably affected. No clear metal lacquer of any type has yet been developed which will completely prevent the stain spotting on cast work unless the castings have been cleaned satisfactorily.

There are many so-called greaseless buffing compounds used in buffing metals which are subsequently lacquered without cleaning in any way. Although these compounds generally clean up extremely well and leave the metal bright, it has been shown that most of the so-termed greaseless buffing compounds leave a slight amount of grease on the metal. This quantity of grease is often sufficient to destroy the adhesion of the lacquer to the metal and sometimes soften or imbrittle the lacquer film. Quoting from a letter written by a well-known manufacturer of greaseless buffing compounds—"We are very dubious if you will ever have very good success by lacquering surfaces that have been buffed and not cleaned. Regardless of the quality of the buffing composition used there is certain to be a very small amount of grease substance left on the work. It would appear to us that to do a perfect lacquering operation, the surfaces should be chemically clean. It is considered doubtful if the savings which are to be made by deleting the cleaning operation would not be more than offset by rejected work."

NOTE: All photographs by courtesy of E. I. du Pont de Nemours & Co., Parlin, N. J.

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Editorial Comment continued from Page 317

courage rather than discourage people who were trying to do research in spite of handicaps.

His kindly, broad-gage attitude may well have made a lot of difference in encouraging the youngsters to go on in science while unfriendly criticism might have turned them into real estate agents.

We are not suggesting that erroneous results or questionable conclusions should not be questioned. They certainly should be, but it can be done in a friendly fashion. Those who are inclined to forget that a scientist should be a gentleman, might well study the published discussions of the late Dr. H. M. Howe, or, among contemporaries, of Dr. Jeffries and Prof. H. F. Moore. They express criticism when it is called for, but never in unfriendly fashion. Criticism of an unfriendly nature might well be reserved for crooks, four-flushers and those who attempt to use technical meetings for blatantly advertising purposes,—though if the Papers Committee is on its job, papers from such sources will not be presented anyway.

Some people are born friendly, and go through life constantly acquiring the good will of their co-workers and acquaintances. With others, this facility has to be developed. If one will figure that perhaps at some future day, he may want a favor from a man whom he is tempted to treat in an unfriendly fashion and that such a man, even though not as yet in a position to grant any favors may some day work himself into such a position, one's attitude may gradually change, and one's ability to gather goodwill may increase.

There are no school or college courses in this, though it can be taught by example of, and contact with, friendly personalities. It is, nevertheless, a matter to which the young scientist might well devote some thought and self-examination, for on few other qualities does his success so much depend.—H. W. GILLETT

Plating on Zinc Die Castings

BY E. A. ANDERSON* AND E. J. WILHELM*

ZINC is being successfully plated on an extensive scale. Nevertheless there are two reasons why not all plating has been satisfactory. One is a lack of adequate thickness of coating. The other is lack of knowledge of the proper method for plating upon zinc.

The first fault may be due to the use of improper methods or to cost-cutting at the expense of quality. The purchaser is to blame for the poor result as often as the supplier.

Reference has been made to a proper method for plating upon zinc. Every base metal requires a plating procedure adapted to it. The method which the writers consider best adapted to zinc either in the rolled or die cast form has been previously described.** This method is not inflexible but modifications of it demand a knowledge of the principles on which it is based. It is the purpose of this paper to describe these principles.

PREPARATION FOR PLATING

Practically all plated articles are brought to a high luster by grinding, buffing and coloring before plating. These operations may readily be accomplished on zinc. The only precautions to be observed are to avoid too high a wheel speed, 5000 to 6000 peripheral feet per minute is acceptable, and to use a dry coloring compound. The use of lime white should be avoided. The reasons for these requirements will become evident in the discussion of cleaning.

CLEANING, RINSING AND ACID DIPPING

Cleaning is a much more complicated task than is generally recognized. Every plater knows that good adhesion cannot be obtained over a greasy surface, but apparently it is not as clearly realized that grease removal is only half the problem of cleaning.

For cleaning some metals other than zinc, hot aqueous solutions of strong alkalies are effective and safe, but such materials react with zinc and other amphoteric metals to form ampholytes which are almost as conducive to poor adhesion as the grease film originally present. It is essential in the cleaning of zinc that the cleaner used be selected to give the least possible attack on the metal. A practical rule is that any cleaner which produces a strong tarnish film in less than two minutes should be avoided.

Since a minimum exposure to even a mild cleaner is desirable, the use of a dry coloring compound in the preparation of the article is of value. If excessive grease is present from some unavoidable cause, an organic solvent may be used prior to the usual cleaning.

The writers have found the following solution and method to give excellent results on zinc:

Tri-sodium phosphate—6 ounces per gallon. Use boiling hot as an electro-cleaner with sufficient current to cause copious gassing. $^1/_2$ to 2 minutes should be sufficient for complete cleaning.

Commercial cleaners designed for zinc are available. These should be used in accordance with the manufacturer's directions and with the above precaution against excessive tarnishing.

Following the cleaning, a *hot*, clear water rinse is recommended. As the article leaves the cleaner it holds an adhering film of hot solution, saturated with zinc salts and sodium stearate (or the sodium salt of other fatty acids which may be present in the grease binder of the buffing compound). Should the work be plunged into a cold water rinse, the lowered solubility of these compounds would permit deposition on the surface and in the contracting pores and crevices, which occur in the surface of practically all metals. A hot water rinse, on the other hand, will remove this film

* Metal Section, Research Division, New Jersey Zinc Company, Palmerton, Pa.

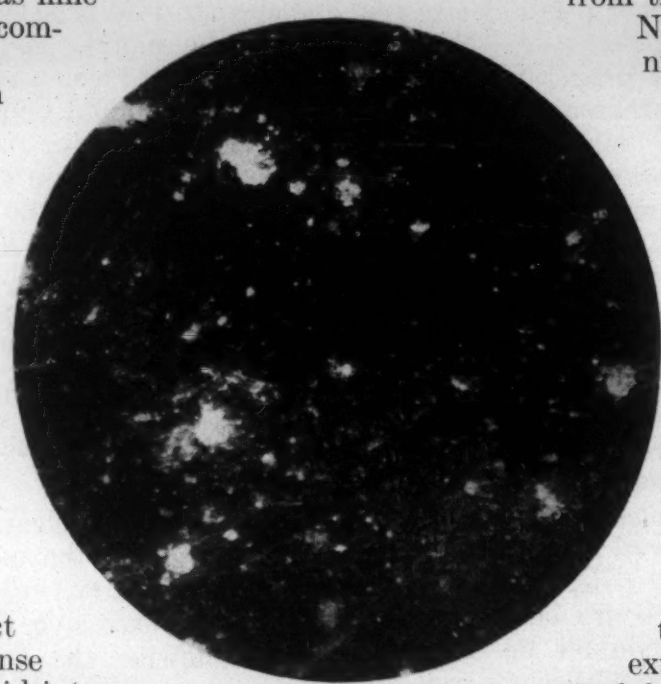
** Plating of Rolled Zinc and Zinc Base Die Castings—Research Bulletin—New Jersey Zinc Company, New York City.

Die cast radiator emblem bar plated with nickel and chromium.

and keep the pores open until the solution is washed out, thus minimizing the danger of poor adhesion from these sources. A cold rinse should follow to complete the washing and to bring the article to room temperature before the next step.

Soft water is highly desirable for the cleaning solution and for rinsing as the following considerations will show. A considerable proportion of the buffing compounds used on zinc employ a binder composed mainly of stearic acid. Under the action of the cleaner the stearic acid is saponified to sodium stearate which remains suspended in the cleaner. In the presence of soluble calcium salts, sodium stearate reacts to form an insoluble, adherent, calcium stearate which is extremely difficult to remove by rinsing. Thus the presence of calcium, either as a constituent of hard water or as lime white used in coloring, will unduly complicate the problem of cleaning.

The necessity for avoiding tarnish films caused by excessive action of alkalies, has been pointed out. Under favorable conditions, a correct cleaning procedure will often permit successful plating immediately following the rinse. More often, however, the use of an acid dip to remove any remaining alkaline film will be desirable. A $^1/_2$ to 2 minute dip in cold, 1% hydrofluoric acid or 10% hydrochloric acid will remove the adhering zinc salts and will give an additional guarantee of perfect adhesion. With a subsequent rinse in cold water to avoid carrying acid into the plating bath, the article is ready for plating.



Appearance of 0.00015 inch nickel coating after outdoor exposure. Note areas of corrosion.

It is possible that in the attempt to make clear the reasons for the various steps considered, the impression has been given that the process is unduly complicated and burden some. On the contrary, the actual procedure is extremely simple and no more complicated than for other metals. In fact the greater part of what has been said may be applied to the cleaning of other metals.

PRIMARY COATINGS

The writers believe that nickel is by far the most desirable primary coating to apply over zinc, regardless of the final coating to be applied.

There is an occasional advocate of a copper flash coating. The reason given usually is that the copper aids in throwing subsequently deposited nickel into recesses not otherwise coverable. This is not necessarily true. In a nickel solution properly adapted to zinc, the improvement in throwing power of the nickel obtained by the use of a copper flash may be very small. In any event the thickness of nickel deposited over a copper flash in a recess will be too thin to be of any value in protecting the base metal. Any article so complicated in shape as to be impossible to cover completely in a properly regulated nickel bath should be plated with auxiliary anodes. The designer should take into consideration the fact that deep recesses are difficult to cover with a coating of sufficient thickness for adequate protection.

Copper, brass, gold and silver tend to dissolve readily into zinc at room temperature and more rapidly at slightly elevated temperatures. For example, a coating of copper 0.0005 inch thick may be completely absorbed by the zinc base after only 10 days' exposure at 100° C. Therefore, if a copper finishing coat is required it must be protected from absorption by a primary nickel coat. If copper is used as a primary coating the adherence of subsequent coatings may be affected by its ultimate diffusion into the base metal.

All of the 4 metals mentioned above must be deposited from cyanide solutions for successful deposition directly on zinc. Cyanide solutions demand extreme care in order to avoid blistering. In those cases of blistering on nickel plated die castings that have come to our attention, the cause has usually been found to be a flash copper coating which has lifted away from the zinc.

None of these difficulties occur when nickel is properly applied as the primary coating directly on zinc. The few occurrences of blistering of nickel on zinc which have been brought to the writers' attention have been the result of insufficient or improper cleaning.

NICKEL PLATING

The durability of plated coatings is dependent largely on their thickness, a fact that is slowly being realized by users. Plated coatings on zinc die castings for outdoor exposures should be at least 0.0003-inch thick. In the past, and to a certain extent to-day, it is not uncommon to find deposits of nickel on zinc die castings as thin as 0.00005 inch.

Almost any kind of a solution can be used to put a very thin nickel coating on zinc, since the defects in some baths are not apparent until the deposit becomes heavy, but certain essentials discussed below must be respected if a good quality heavy coating is to be obtained at low cost.

When zinc (or any other metal above nickel in the electro-chemical series) is placed in an electrolyte containing nickel ions, the normal replacement phenomenon takes place with zinc going into solution and nickel depositing on the article. Normally, the resulting deposit is a non-adherent black coating which offers no great value either for protection or decoration.

It is necessary, in order to obtain bright electrodeposits, that a sufficiently high current density and a low enough nickel ion concentration be used to prevent this immersion deposition. In the earlier days of plating on zinc, baths of very low nickel content were common. These solutions functioned fairly well since the low metal content automatically provided a low ion concentration.

The objection to this type of bath lies in the fact that a large proportion of the nickel present is ionized. As the plating proceeds the nickel ions in the film adjacent to the cathode are depleted and, since the concentration of un-ionized nickel is too low to immediately replenish the nickel ions removed, polarization increases. Since the nickel present in the remainder of the solution exists largely as nickel ions, replenishment of the cathode film must take place by the slow process of ion migration or by means of convection currents. The net result is an extremely low ion concentration in the

cathode film and a very fine grained, hard, brittle nickel deposit.

A better plating solution would obviously be one with a high nickel content but with a low nickel ion concentration. This can readily be realized in 2 ways; the addition of sodium sulphate will depress the normal ionization of nickel sulphate by the common ion effect; and sodium citrate also acts to depress the ionization of nickel sulphate, although the mechanism by which it operates is not clearly understood.

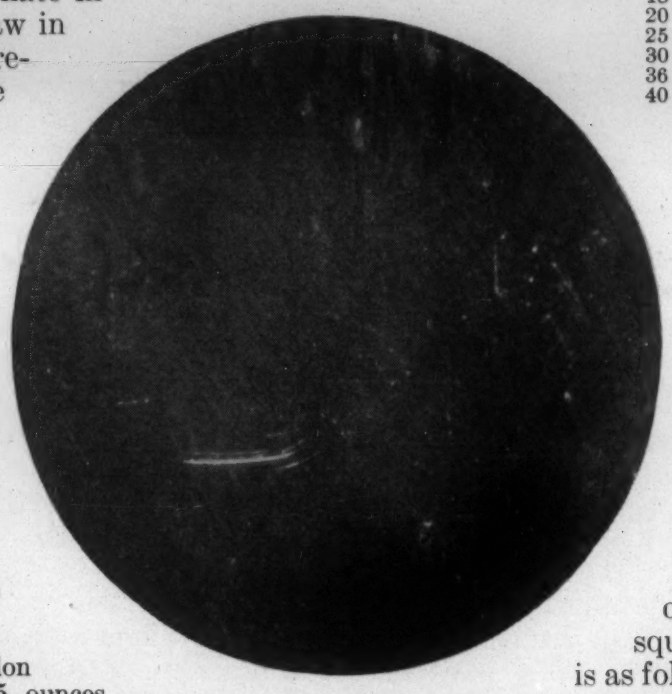
The situation in the cathode film changes when a large quantity of undissociated nickel sulphate is available. As fast as nickel ions are deposited un-ionized nickel present in the film can become ionized. Convection currents caused by gas evolution tend to keep up the supply of nickel sulphate in the cathode film as well as to draw in fresh supplies of ions and hence prevent excessive polarization. The nickel coating produced in this manner can be carried to 0.0003 inch without trouble.

Commercial baths embodying both of the above principles of ionization depression have been in use for some time. The writers prefer the sodium sulphate bath on the basis of its better conductivity, throwing power and overall efficiency.

The following bath has been used with good success and is recommended for zinc and zinc alloys:

Single nickel salts—10 ounces per gallon
Anhydrous sodium sulphate*—10–15 ounces per gallon
Ammonium chloride—2–3 ounces per gallon
Boric acid—2 ounces per gallon

* If the hydrated salt is used, add double the amount.



Appearance of 0.0003 inch nickel deposit after same exposure. Note freedom from corrosion.

The sodium sulphate content should be regulated in accordance with the shape of the objects to be plated. Softest deposits are obtained with the minimum addition of this salt. The current density should be controlled between 12 and 18 amperes per square foot. If possible, a somewhat higher initial current should be used for 1 or 2 minutes in order to minimize the danger of streaking.

The bath is best operated at pH of 5.8 to 6.2 (colorimetric uncorrected).* Ammonium hydroxide or sulphuric acid should be used in making adjustments. The relation between anode and cathode areas should be controlled to minimize such adjustments. If the solution continuously becomes alkaline, the nickel content is increasing too rapidly and the anode area should be reduced. Conversely, an acid condition may be controlled by increasing the anode area.

It is customary to operate the sulphate bath at room temperature. It would, perhaps, be advisable to impose more definite limits, since most plants have no facilities for control of temperature in the hot months. Best results are obtained at 26° C. (79° F.) although successful plating is feasible between 24° and 30° C. (75° to 86° F.). Too low a temperature facilitates the formation of brittle deposits by unduly depressing ionization while warm solutions tend to cause streaks due to the reverse effect.

It will be noted from the formula that the nickel content of the bath, calculated as metal, is about 2 ounces per gallon. There should be no difficulty in holding closely to this amount. It is advisable, however, to check the nickel content at intervals. In this connection the writers have found no difficulty in using 99% nickel anodes with this bath.

* Corresponds to 5.3–5.7 by the quinhydrone electrometric method.

The two-ounce nickel, high-sulphate bath has a high cathode efficiency and permits the deposition of nickel at a fairly rapid rate. Table 1 shows the plating time necessary, at various current densities, to deposit 0.0003 inch of nickel.

Table 1.—Time in Minutes to Produce 0.0003 Inch of Nickel at Various Current Densities

Current Density amps./ft.^{2}	Time—Minutes
8	46
10	38
15	22
18	21
20	20
25	15
30	13
36	11
40	9.5

It will be seen that at its upper usable limit of current density (about 20 amps./ft.^{2}) this bath can deposit 0.0003 inch of nickel in 20 minutes. Frequently the demand on equipment is such that shorter periods must be employed. Since this requires the use of higher current densities to maintain a satisfactory standard of thickness, the two-ounce solution has been modified to permit operation up to 36 amperes per square foot. The improved solution is as follows:

Single nickel salts—15–18 ounces per gallon
Anhydrous sodium sulphate*—15 ounces per gallon
Ammonium chloride**—3 ounces per gallon
Boric acid—2 ounces per gallon

* If hydrated salt is used add double the amount.
** The simultaneous addition of nickel sulphate and ammonium chloride brings the solution nearer to the solubility limit of the nickel ammonium sulphate formed in the bath. For this reason any addition of ammonium chloride beyond 3 ounces per gallon should be made cautiously and pH adjustments should be made with sodium hydroxide or hydrochloric acid as required.

This solution is used at 24-30° C. with a colorimetric* pH range of 5.4-5.9. The plating range is 24-36 amperes per square foot. Inspection of Table 1 will show that at a maximum current density, 0.0003 inch of nickel can be applied in 11 minutes.

This bath has been found commercially practical and in appearance and quality the deposits are equal to the slower deposits from the two-ounce solution.

TESTS ON PLATED COATINGS

The necessity for adequate thickness of coating, and the imperfect recognition of this necessity have been mentioned. The percentage difference in cost between coatings which are too thin and those that are satisfactory is very small. Certainly the nickel and the current used represent a small proportion of the total cost of plating. Polishing and buffing, which have little or nothing to do with the plating operation itself, represent a much larger proportion of the costs. Yet small cost differences may govern if the quality difference is not understood.

From the plater's standpoint the competition of non-rusting white metals demands that he look to the

* Corresponds to 4.9–5.4 electrometric.

Die cast radiator cap successfully plated with nickel and chromium on a commercial scale. Note that the overhang of the wings imposes a severe requirement on throwing power.

quality of his work. There is a tendency to blindly assume that lack of complaints means a satisfactory product. This is not necessarily true because, in the first place, some time must elapse before even a poor plating job will fail. In the second place, the plated article frequently passes through several hands, in the processes of manufacture and distribution, before reaching the ultimate consumer. These circumstances unquestionably minimize the chances of a positive complaint coming back to the plater. There is nothing, however, to prevent a suspicion in the mind of the consumer that all plated ware may be unreliable if he happens to encounter one or two plated articles of unsatisfactory durability. This frame of mind makes the consumer receptive to competitive substitutes and thus reacts upon the entire plating industry.

A serious handicap to intelligent buying lies in the difficulty of finding suitable tests for the plated material. The failure of the well-known salt spray test to serve as a yardstick of service performance has been considered in detail elsewhere.* Other laboratory and plant tests have been suggested, all of which have the same fundamental defect as the salt spray test; namely, that they fail to predict correctly the service life of a series of materials.

The writers have become convinced, after several years of corrosion studies, that the best way to determine how long a given material will last in the outdoor atmosphere is to expose it to the outdoor atmosphere. They do not know of any accelerated test which can be trusted to forecast the true service life of plating.

The writers have conducted numerous continuous atmospheric exposure tests as well as service tests on plated zinc alloy die castings. The results confirm the statement that the minimum thickness of nickel which is satisfactory over zinc for outdoor service is 0.0003 inch. Thinner coatings are distinctly inferior and thicker coatings do not seem to be required to give the life which may reasonably be expected.

* *Metals & Alloys*, Vol. 1, Aug. 1930, pages 667–671.

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The Use of Aluminum for Oil Lease Tanks

The corrosive action of concentrated brines on aluminum tank plates under different operating conditions is described by the United States Bureau of Mines, Department of Commerce, in Report of Investigations 3131, "The Use of Aluminum for Oil Lease Tanks: Part II–Laboratory Tests." by Ludwig Schmidt, John M. Devine and C. J. Wilhelm.

In order to study corrosion conditions encountered in the tanks during the test period, a laboratory was maintained at the site of the aluminum lease tanks.

All metals have an inherent tendency to go into solution when in contact with water. The extent of this tendency varies for different metals, depending upon their position in the electromotive series. Investigators generally agree that aluminum owes its resistance to corrosion to the protective action of a superficial layer of oxide which is established in sites by autoxidation. Inasmuch as the metal itself is located relatively high in the electromotive series, it is evident that any set of conditions whereby the oxide film is ruptured or rendered pervious to aqueous solutions will result in rapid corrosion of the metal when in contact with such solutions.

The potential corrosive agents to which the aluminum tanks were subjected in service included natural gas, oil and salt water, each of which contained free hydrogen-sulphate gas in varying proportions. The field test proved that natural gas and oil were without corrosive effect on the tanks. The salt water, however, was capable of producing serious corrosion. Hydrogen sulphide, in dissolved or free state, did not have any direct action on the tanks, but indirectly it was a contributory factor to corrosion through the production of iron sulphide by interaction with the steel flow lines. Iron sulphide, so formed, was flushed into the tanks and functioned as an accelerator to salt-water corrosion.

All of the corrosion in the aluminum tanks was of highly localized nature, resulting in a pitting attack. Nevertheless, it was possible to identify three distinct types of corrosion:

(1) Low-temperature salt-water corrosion, which was encountered where aluminum side sheets of tanks were exposed to the action of salt water.

(2) High-temperature salt-water corrosion, which was encountered in the corrosion of aluminum steam-heating coils within the tanks.

(3) Bimetallic corrosion, which was caused or accelerated by the proximity of steel in electrical contact with aluminum; such corrosion resulted where steel steam-heating coils were installed in aluminum tanks.

SHERARDIZING

BY FRED L. WOLF*

PRIOR to 1910 and 1911, most of the electrical line materials, made of malleable iron for use in connection with street railways and mines, were protected against corrosion by means of paint, japan and the electrogalvanizing process. About this time the trade became more critical and demanded better rust proof castings to be supplied.

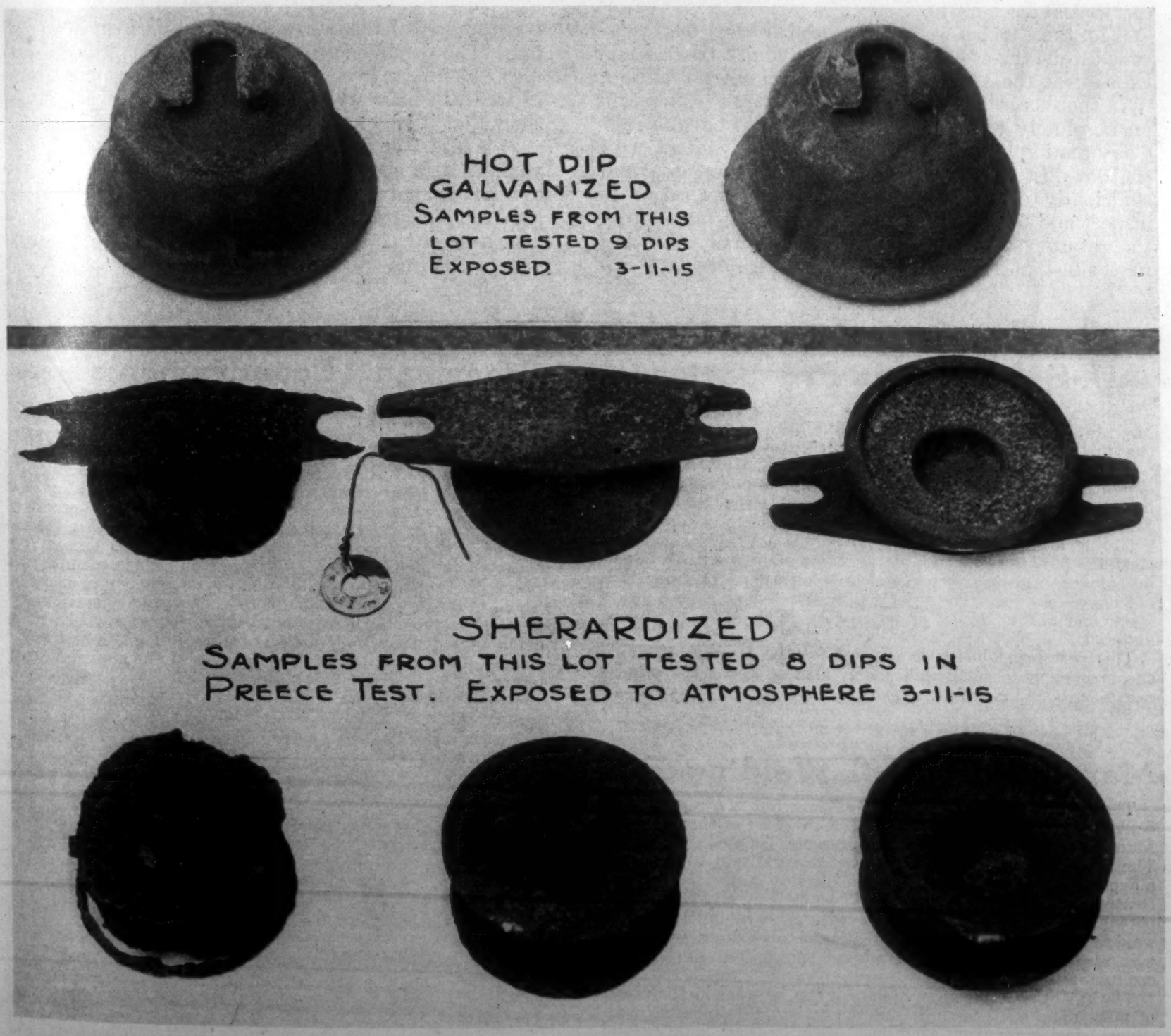
The Ohio Brass Company then installed a hot galvanizing plant, but considerable trouble was encountered due to malleable iron becoming brittle after hot dipping. It was also found impossible to hot dip threaded material satisfactorily.

About 1910 and the early part of 1911, the sherardizing process was brought to our attention. A small experimental unit was built, considerable development work was carried on, the results of which were quite satisfactory, and we succeeded in turning out a good rust proof coating on castings. Threaded material could easily be treated and the embrittlement effect which was encountered when treating malleable iron by means of hot galvanizing process was much less pronounced.

Early in 1911, a license was taken out, production furnaces were built and the sherardizing process was established as a standard method for rust proofing our castings.

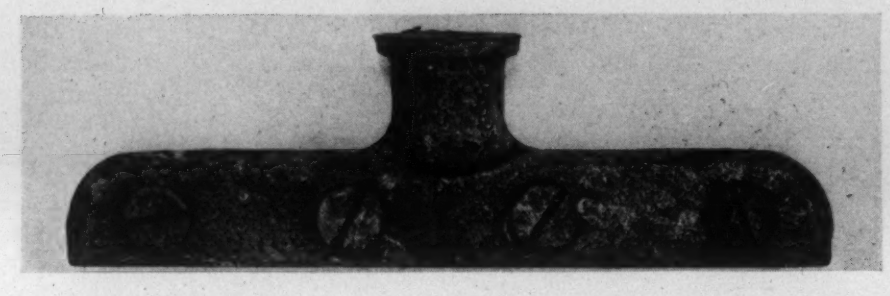
Without going into a lengthy recital of experiences and details, it was found that it was necessary to do a large amount of research work to determine the proper

* Technical Superintendent and Chief Engineer, The Ohio Brass Company.



Hot dipped and sherardized castings exposed outdoors from March 1915 to October 1931. The hot-dipped specimens show some discoloration of the zinc, but no corrosion of the casting itself, while the sherardized castings are badly pitted.

metallic content of zinc dust used, the time involved, the temperatures, etc. During the periods 1911 and up to the time this company discontinued the sherardizing process (Dec. 1, 1923), weekly samples of castings treated by both the sherardizing and the hot dip galvanizing processes were exposed to the atmosphere for the purpose of observing what corrosion, if any, took place. There were probably several tons of castings exposed for this purpose, most of which are still available and on hand. Observations over a long period of time have shown that castings treated by the sherardizing process are very much inferior, when it comes to the question of withstanding corrosion over a long period of time, to those treated by the hot dip galvanizing process. Inspecting castings exposed since 1911, the author would say that at least 50 to 75% of those which were sherardized are very badly corroded while the castings hot dip galvanize treated and exposed at the same time show absolutely no failures.



A sherardized clamp casting, sherardized in an electric furnace with all factors under good control. The casting was never exposed to out-door corrosion, having been in a stock bin for about one year. It shows appreciable corrosion.

In the sherardizing process it was difficult to maintain an absolutely uniform condition so as to be sure that every casting had been brought in proper contact with the zinc dust, and to be sure that it was completely and sufficiently coated. Every precaution was taken to inspect and test each lot of castings as they came from the retorts, setting a minimum of 6 dips using the Preece test, and in spite of proper furnace design, pyrometric control and technical supervision, it was found impossible to maintain uniformity.

When it was discovered that the great problem of embrittlement could be eliminated by the proper treatment of malleable iron castings prior to hot dip galvanizing and also that by means of properly designed centrifugal machines threaded material could be hot dipped, the company at once discontinued the sherardizing process and treated all castings by means of hot dip galvanizing. The author believes a check up over a period of years will show that the sherardizing process has not been satisfactory and that very few concerns are still carrying on.

It is true that if all conditions are right an excellent rust proof coating can be obtained by sherardizing. If the casting is covered 100% properly its resistance to corrosion will be equal to any hot dip galvanized coating. The trouble lies in the fact that sherardized castings which have been tested under corrosive conditions as well as others which have been observed in service show that it is not possible to produce a 100% job.

It is also true from observations over a period of 20 years that in no case has the author observed a failure of a hot dip galvanized casting when exposed to normal atmospheric corrosion but sherardized castings exposed over a similar period showed at least 50 to 75% partial or total failures.

◆ ◆ ◆ ◆ ◆

U. S. Mint Aids Prospectors

State Mineralogist, Walter W. Bradley, has been advised by Mr. M. J. Kelly, Superintendent of the Mint at San Francisco, that the Mint now accepts gold in quantities of 2 ounces and over.

The rules and regulations governing the U. S. Mints state that a deposit must be of $100 value before it can be received, but prior to 1926, deposits of $50 value were accepted at the San Francisco Mint. In 1926 orders came from Washington to adhere to the $100 rule, and this order has been enforced until this year, when on June 2nd, the Director of the Mint authorized the Superintendent at San Francisco to accept deposits of gold in quantities of 2 ounces or over. The order applies only to gold in the natural state, and not to dental or jewelry scrap, or other fabricated material.

This permission has been granted for the purpose of giving encouragement to small-scale placer mining during the present season only, and is not permanent.

◆ ◆ ◆

Manganese Steel Welding Rod

The AMSCO Manganese Steel welding rod is a result of research work done at the Chicago Heights plant of the American Manganese Steel Company, commencing several years ago. The rod was developed to give a welding rod that would leave a deposit equivalent in analysis and physical properties to heat treated manganese steel; that could be used by any fairly competent welder with the electric arc with good results; and that would not require special heat treating or quenching, but would give the characteristics of standard manganese steel under ordinary air-cooling.

The AMSCO Manganese Steel rod can be used in the repair of manganese steel castings and the reclamation of such manganese steel equipment as dipper teeth, crusher mantles and jaws, railway track members, etc. It can be used for these purposes on parts of ordinary steel and also for a wear resistant coating on almost any kind of steel casting.

American Foundrymen's Association to Return to Philadelphia for 1932 Convention

The 36th Annual Convention and Exhibit of the American Foundrymen's Association will be held in Philadelphia, May 2 to 6 1932, according to an announcement made by the Association. The Convention and Exhibit activities will be centered in the new Municipal Convention Hall, located at 34th St. and Vintage Ave.

Tentative plans for the 1932 program include a number of practical shop-operation and round-table sessions of the type which proved so popular at the 1931 Chicago Convention that the meeting rooms there were taxed to capacity. The Philadelphia Convention Hall, however has broad facilities in the way of meeting rooms to fit any requirement of the annual foundry meeting.

Mechanism of Energizer Action in Carburization

BY R. A. RAGATZ* AND L. O. KOWALKE*

THE remarkable acceleration in the rate of carburization of steel produced by the addition of small quantities of certain alkali and alkaline earth carbonates to solid carbonaceous materials has long been recognized and utilized in the preparation of commercial case hardening compounds. When a pronounced catalytic effect such as this is discovered and gains extensive commercial application, efforts are naturally made to explain the mechanism of its action. One explanation of the rôle played by certain alkali and alkaline earth carbonates was proposed quite a number of years ago and gained wide acceptance if judged by the frequency of its statement in the technical literature. It is only within recent years that this widely accepted theory has been questioned by some. A few investigators who were dissatisfied with the older theory have proposed theories of their own, but these newer ones also are not in entire accordance with certain experimental data. The writers of this paper have performed a series of tests[1] on the energizing action of a great variety of compounds. On the basis of these results, together with certain theoretical considerations, the writers have developed a theory of energizer action which will be presented in this paper.

Before entering upon a discussion of the mechanism of energizer action, it will be desirable to discuss: 1. The mechanism of carburization with pure carbon. 2. The decomposition temperatures of carbonates in an atmosphere composed of carbon monoxide and carbon dioxide. Then a discussion of the previously proposed theories will be in order. Finally, the explanation of the writers will be offered.

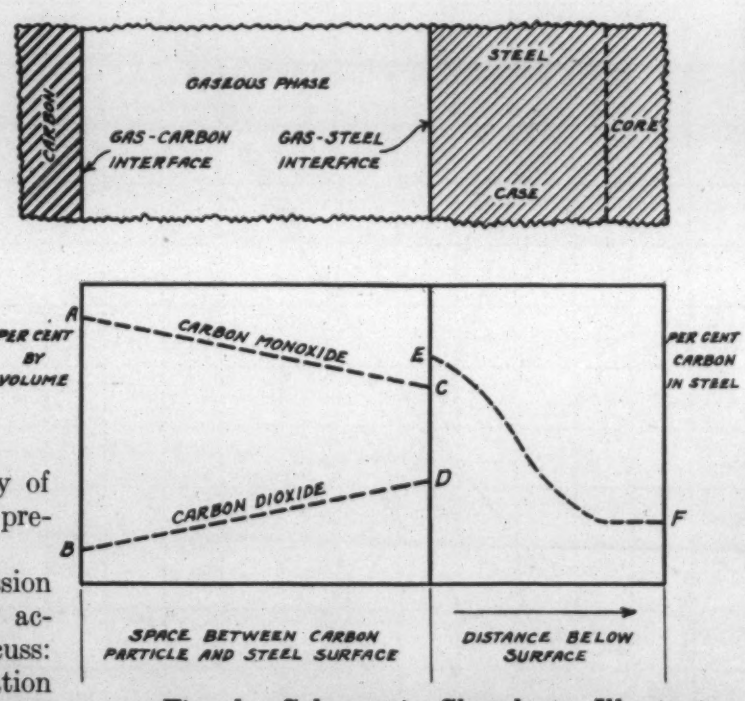


Fig. 1. Schematic Sketch to Illustrate Conditions during Carburization.

A—% CO at the Gas-Carbon Interface.
B—% CO_2 at the Gas-Carbon Interface.
C—% CO at the Gas-Steel Interface.
D—% CO_2 at the Gas-Steel Interface.
E—% C in Steel at Outer Surface.
F—% C in Uncarburized Steel.

MECHANISM OF CARBURIZATION

Most texts on the heat treatment of steel discuss carburization in a purely empirical manner, without making any attempt to clearly picture the kinetics of the process and without discussing the reactions involved from the standpoint of physico-chemical theory. The carburization of steel will be treated from the latter viewpoint, because it presents a clear-cut picture of the mechanics of carburization which is essential to an understanding of the discussion on the action of energizers. To simplify matters, it will be assumed that the carburizing agent is pure solid carbon, rather than a carbonaceous material that evolves large quantities of gas on heating.

The question of direct interaction between the solid carbon and the steel should first be considered. If a piece of steel is heated in contact with pure solid carbon in the total absence of all gases, can the carbon migrate directly into the steel? Controversy over this point engaged the attention of metallurgists for many years. The work of the various investigators has been reviewed in detail by Giolitti.[2] The present conclusion is that pure solid carbon, in the total absence of all gases, can act directly on steel, but it is an extremely slight action, and can be entirely neglected from a practical standpoint.

This conclusion applies to the carbonaceous material in which the steel was originally packed. A similar question might be asked with respect to the pure carbon precipitated on the steel in very finely divided form by the decomposition of certain gases such as carbon monoxide or hydrocarbons. As will be pointed out later, 2 investigators hold the belief that such finely divided carbon can readily be absorbed by the steel.

Now consider what takes place when steel is heated to a temperature in the vicinity of 1750° F. (955° C.) in a carburizing box packed with pure solid carbon. The air entrapped in the box will combine with carbon to form an atmosphere consisting of nitrogen, carbon monoxide and carbon dioxide. The carbon monoxide will react with the steel according to the following reaction:

$$3Fe + 2CO \longrightarrow Fe_3C + CO_2 \quad \ldots (1)$$

The cementite thus formed at the outer surface of the steel dissolves and diffuses inward. The carbon dioxide which is a by-product of the carburizing reaction is regenerated by the hot carbon, as indicated by the following reaction:

$$CO_2 + C \longrightarrow 2CO \quad \ldots\ldots\ldots (2)$$

The carbon monoxide then reacts with the steel, thereby carrying the process of carburization further. It is evident that the gases act in a cyclic manner and that the carbon monoxide acts as a carrier of carbon from the carbonaceous solid to the steel.

Fig. 1 illustrates in schematic form the conditions at some particular time during the carburizing process. The upper sketch indicates, on a highly magnified scale, a particle of carbon close to the surface of the steel, with an intervening gaseous phase that consists of nitrogen, carbon monoxide and carbon dioxide. At the surface of the carbon, a definite concentration of carbon monoxide as indicated by point A will be established, while at the surface of the steel another and somewhat lower concentration of carbon monoxide will be established as indicated by point C. The lower concentration of carbon monoxide at the steel surface with respect to its concentration at the carbon surface is due

* Chemical Engineering Department, University of Wisconsin.

to reaction (1). A gradient of carbon monoxide concentration is thus established which causes the carbon monoxide to diffuse from the carbon surface to the steel.

The conditions with respect to the carbon dioxide are just the reverse. At the steel surface its concentration is increased by reaction (1), while at the carbon surface its concentration is decreased as a result of reaction (2). In this way, a gradient of carbon dioxide is established that causes the carbon dioxide to diffuse from the steel surface to the carbon surface, countercurrent to the flow of carbon monoxide.

The flow of carbon monoxide and carbon dioxide between the two interfaces where the reactions are occurring is entirely a diffusional process, as convection currents may be assumed to be absent in the gaseous phase after the carburizing temperature is established. The flow of gas between the 2 surfaces therefore proceeds according to Fick's Law of diffusion:

$$\frac{dW}{dt} = -Dq\left[\frac{dc}{dx}\right] = \text{weight of material transferred per unit of time} \quad \ldots\ldots (3)$$

D = diffusion constant
q = area
$\frac{dc}{dx}$ = concentration gradient.

Any attempt to apply Fick's law in a quantitative way to the process of carburization is beset with many difficulties, as it requires a knowledge of the concentration gradient between carbon and steel. The concentration gradient is determined by: 1. The gas composition at the gas:carbon interface, 2. The gas composition at the gas:steel inferface, 3. The mean effective distance between the carbon particles and the steel.

The equilibrium gas compositions have been determined for the $C:CO_2:CO$ system[3,4,5,6] and for the steel:$CO:CO_2$ system.[7,8,9] However, these values do not necessarily give the gaseous compositions at the gas:carbon and the gas:steel interfaces, as it is always questionable whether the equilibrium values are assumed at the interfaces in a heterogeneous chemical reaction, particularly if one phase is a solid and the other a gas.[10,11] At the steel:gas interface an additional complication arises due to the constantly varying carbon content of the austenite, which demands constantly changing gas compositions for equilibrium.

Since the carburizing agent consists of a large number of carbon granules which are in actual contact with the steel at certain points, it is difficult to determine what shall be considered the mean effective distance between steel and carbon.

Though a quantitative application of Fick's Law to the carburizing process is difficult, some interesting qualitative deductions may be drawn. The rate of material transfer from carbon to steel is directly proportional to the concentration gradient $\left(\frac{dc}{dx}\right)$. If this gradient is increased either by increasing the concentration difference (dc) or by decreasing the effective distance (dx), the velocity of carburization will be increased. This point has a bearing on the proposed explanation of energizer action, as will be pointed out later.

In a discussion of the mechanics of carburization, consideration should be given to the manner in which the carbon migrates to the interior of the steel. Formerly the view was held that the gas actually diffused into the steel and that the carburizing reaction was not confined to the surface of the steel, but also took place in the interior regions. The researches of Takahashi[12] proved this to be incorrect. He demonstrated that the reaction is confined to the outer surface of the steel, and that the iron carbide formed there dissolves and migrates into the steel by a process of diffusion.

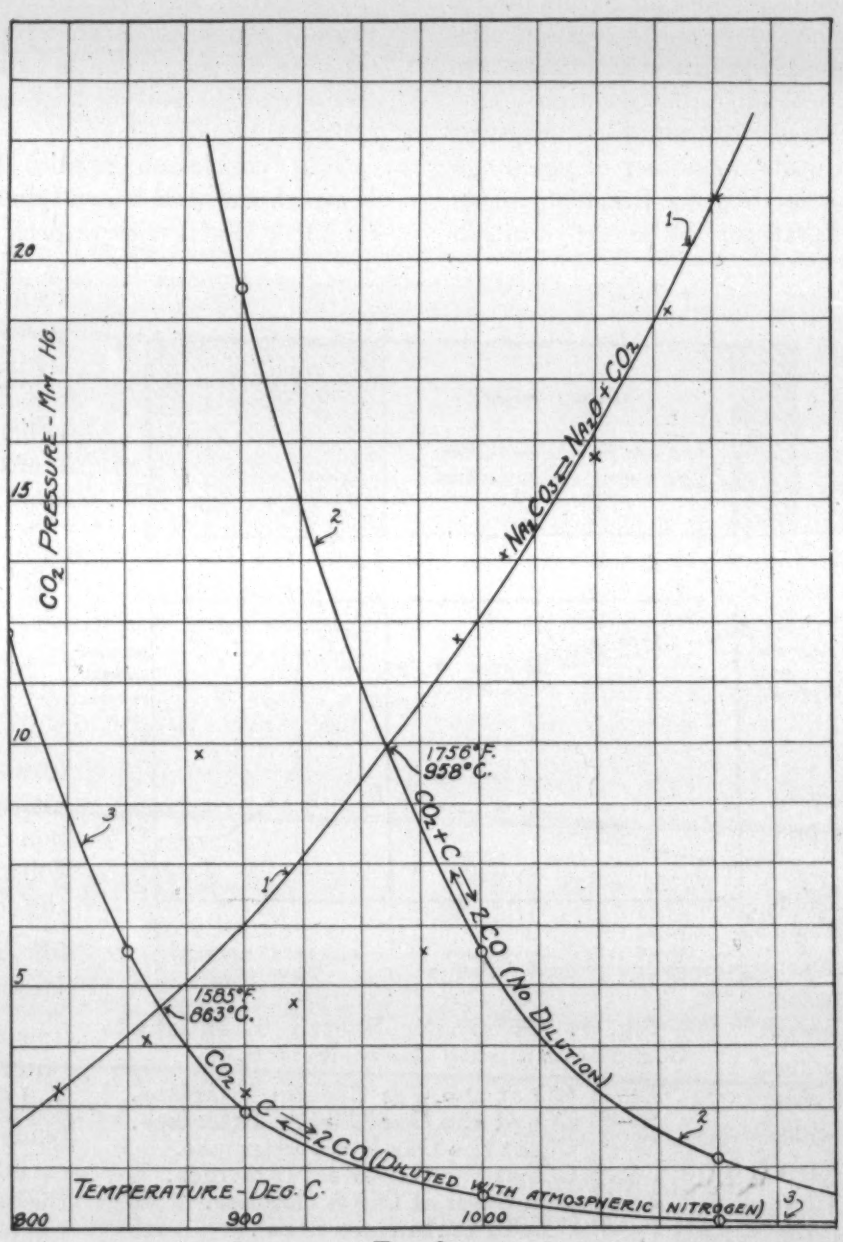


Fig. 2.

DECOMPOSITION OF CARBONATES

Discussion of the theories proposed to explain the action of carbonate energizers requires that certain points regarding the decomposition of carbonates be clearly understood.

When a carbonate is heated in the absence of carbon, it tends to dissociate into metallic oxide and carbon dioxide as indicated by the following general equation:

$$MCO_3 \rightleftarrows MO + CO_2 \quad \ldots\ldots (4)$$

At each specific temperature the carbonate will tend to establish a definite pressure of carbon dioxide. The decomposition of the carbonate according to the above equation will be determined by the relation between the pressure of carbon dioxide the carbonate tends to establish, and the partial pressure of carbon dioxide existing in the gaseous phase in contact with the carbonate. If the carbon dioxide pressure in the gaseous phase is less than that of the carbonate, decomposition of the carbonate will occur according to reaction (4). Conversely, if the carbon dioxide pressure in the gaseous phase is greater than that of the carbonate, any metallic oxide which is present will revert to carbonate.

The velocity at which a carbonate will decompose or the velocity at which it is re-formed from metallic oxide and carbon dioxide will be determined by: (1) The differential between the carbon dioxide pressure of the carbonate and the partial pressure of carbon dioxide in the gaseous phase. (2) The velocity of the gas, if it is circulated around the particles of carbonate. Furthermore, when the carbon dioxide pressure of the carbonate equals the total pressure of the gaseous

phase, decomposition will be very rapid, as the carbonate in effect "boils."

How will carbon, when present in considerable amount, affect the direct decomposition of carbonate according to equation (4)? It is well known that at constant pressure, the $C:CO:CO_2$ system tends to establish a definite composition of gas at each specific temperature. The composition of the gaseous phase will be altered by dilution with atmospheric nitrogen, but may readily be computed if the equilibrium gas composition with no nitrogen dilution is known. The possibility of a carbonate decomposing directly, according to equation (4), will be determined by the relation of its carbon dioxide pressure to the partial pressure of carbon dioxide in the gaseous phase, as established by the $C:CO_2:CO$ equilibrium.

Reference to Fig. 2 will help in this discussion. This graph shows the relation between the pressure of carbon dioxide and the temperature, for the following reactions: (1) $Na_2CO_3 \rightleftarrows Na_2O + CO_2$, (2) $C + CO_2 \rightleftarrows 2CO$ when no diluting nitrogen is present and the total pressure is 1 atmosphere, (3) $C + CO_2 \rightleftarrows 2CO$ when the gases are diluted with atmospheric nitrogen, and the total pressure is 1 atmosphere. The intersection of curves 1 and 2 gives the minimum temperature (1756° F., 958° C.) at which sodium carbonate can decompose directly, according to equation (4), when no diluting nitrogen is present. Dilution with atmospheric nitrogen lowers the minimum temperature of direct decomposition to 1585° F. (863° C.), as indicated by the intersection of curves 1 and 3.

In Table 1 are given the minimum temperatures of direct decomposition for various carbonates, determined as indicated above.[13] The limitations of these figures should be clearly understood. They only represent the minimum temperatures at which various carbonates can decompose *directly*, according to equation (4). In some instances, it is possible that direct interaction between carbon and carbonate takes place. Decomposition of the carbonate under these conditions may possibly occur at lower temperatures than those indicated in Table 1. However, the data given in Table 1 are of value as they have an important bearing upon some of the theories that have been proposed to explain the action of energizers.

Table 1.—Minimum Temperatures of Direct Decomposition of Various Carbonates in the Presence of Carbon at One Atmosphere Pressure.

Carbonate	Decomposition Temperature: Gaseous Phase $CO + CO_2$		Decomposition Temperature: Gaseous Phase $CO + CO_2$ Diluted with Atmospheric Nitrogen	
	1612° F.	878° C.	1472° F.	800° C.
Li_2CO_3 Johnston*				
Li_2CO_3 Lebeau**	1571	855	1400	760
Na_2CO_3	1756	958	1585	863
K_2CO_3	1792	978	1620	882
$MgCO_3$	959	515	932	500
$CaCO_3$	1441	783	1335	724
$SrCO_3$	1720	938	1607	875
$BaCO_3$ First step†	1872	1022	1760	960
$BaCO_3$ Second step††	1909	1043	1805	985

* and ** Decomposition pressures for Li_2CO_3 as determined by Johnston and Lebeau are not in good agreement.
† $2\ BaCO_3 \quad BaO{\cdot}BaCO_3 + CO_2$.
†† $BaO{\cdot}BaCO_3 \rightleftarrows 2\ BaO + CO_2$.

Some reference works on inorganic chemistry state that certain carbonates, such as barium carbonate for example, can react directly with solid carbon according to the following reaction.[14,15]

$$MCO_3 + C \longrightarrow MO + 2\ CO \qquad (5)$$

The idea that such direct interaction occurs in some instances appears to be based upon the well known fact that the calcination of barium carbonate in commercial practice is greatly accelerated by the addition of carbon. Though no detailed research appears to have been carried out on reactions of this type, some experimental data afford indirect evidence that reactions of such type do occur and that they take place at lower temperatures than the minimum temperatures of direct decomposition listed in Table 1. Rapatz[16] investigated the decarburization of high carbon tool steel in various packing materials and found that the addition of sodium or barium carbonate to charcoal reduced or completely inhibited decarburization at those temperatures at which charcoal alone exerted a decided decarburizing effect. This appears to indicate that the presence of the sodium or barium carbonate creates a gaseous atmosphere higher in carbon monoxide than is normal for the $C:CO_2:CO$ equilibrium. This would result if the carbon and carbonate reacted directly to form carbon monoxide. Fox and White[17] present data showing that at 1470° F. (800° C.) (a decidedly lower temperature than that given in Table 1 for sodium carbonate) the addition of sodium carbonate to carbon gives a gaseous atmosphere of higher carbon monoxide content than is normal for the $C:CO_2:CO$ equilibrium. This again indicates direct interaction of carbonate with carbon, resulting in the production of carbon monoxide. In view of this indirect evidence and the lack of data to the contrary, we have concluded that direct interaction of carbon with carbonate can occur at temperatures below the minimum temperatures of direct decomposition as given in Table 1.

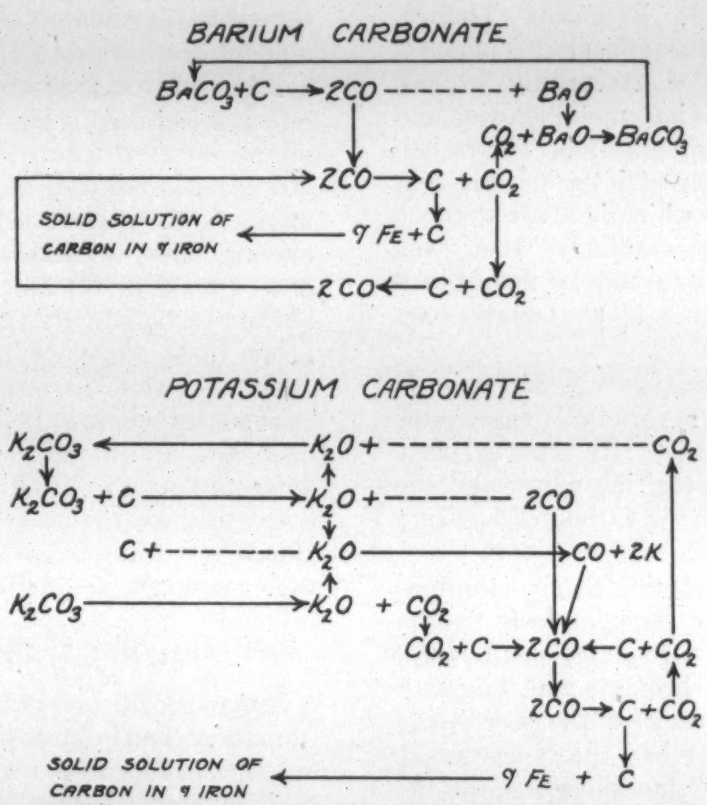


Fig. 3. Cyclic Reactions Proposed by Fetchenko-Tschopiwskij.

In the case of sodium and potassium, the metallic oxide formed by reaction (5) will react further with the carbon to form carbon monoxide and sodium vapor, as indicated by the following reaction.[18]

$$Na_2O + C \longrightarrow CO + 2Na \qquad (6)$$

The oxides of lithium, barium, strontium and calcium will not react similarly.

In Table 2 are listed the pressures of carbon dioxide that certain carbonates exert at a temperature of 1750° F. (954° C.).[13] This table is of particular interest as it shows clearly which of the metallic oxides act as efficient scavengers for carbon dioxide. For example, at 1750° F. (954° C.), sodium oxide will combine with carbon dioxide if the partial pressure of carbon dioxide in the gaseous phase is above 9.5 mm. However, calcium oxide at the same temperature can absorb carbon dioxide only if the partial pressure of carbon dioxide in the gaseous phase is 1690 mm. or over. Since carburization is always carried out at atmospheric pressure, it is apparent that calcium oxide at 1750° F. will be ineffective as a scavenger for carbon dioxide.

Table 2.—Decomposition Pressures of Various Carbonates at 1750° F. (954° C.)

Carbonate	Pressure of Carbon Dioxide, mm. of Mercury
Li_2CO_3 Johnston	64
Li_2CO_3 Lebeau	75
Na_2CO_3	9.5
K_2CO_3	6.1
$MgCO_3$	See note
$CaCO_3$	1690
$SrCO_3$	16
$BaCO_3$ First step	1.0
$BaCO_3$ Second step	0.3
$C:CO_2:CO$ No dilution	10.5
$C:CO_2:CO$ Diluted with atmospheric nitrogen	1.3

NOTE: Decomposition pressure of $MgCO_3$ not known at 1750° F. At 1292° F. (700° C.) the value is 359,800 mm.

PREVIOUS THEORIES

1. The Simple Carbon Dioxide Evolution Theory. One explanation of energizer action has appeared frequently in the technical literature.[19,20,21,22,23,24] According to this explanation, the carbonate dissociates into metallic oxide and carbon dioxide at the carburizing temperature. The carbon dioxide thus formed reacts immediately with the incandescent carbon to form carbon monoxide, to which is attributed the increased rate of carburization. Accordingly, then, the carburizing efficiency of a compound would be determined by its carbon dioxide content rather than by the metallic part of the compound.

The inadequacy of this simple explanation was first pointed out by Rodman,[25] who worked with a variety of carbonates of the alkaline earth and alkali metals. He reported that there was no relationship between energizing power and the quantity of carbon dioxide available in the various carburizing agents tested.

That the simple carbon dioxide evolution theory is untenable was also shown by an extensive series of tests by the writers.[1] It was shown that sodium carbonate, bicarbonate, hydroxide, acetate, oxalate, cyanide, chromate and tungstate all were approximately equally effective, when the carburizing agents were so proportioned that they had the same weight ratio between charcoal and sodium. Potassium carbonate, bicarbonate, hydroxide, acetate, oxalate, tetraoxalate, cyanide, ferrocyanide, ferricyanide, chromate, dichromate and permanganate were approximately equal in their effects as energizers. Barium carbonate, oxide, hydroxide, acetate and nitrate were also of equal effectiveness. These results indicated that the energizing effect was primarily determined by the metallic part of the compound, rather than by combined carbon dioxide. Furthermore, certain easily decomposable carbonates such as calcium carbonate and magnesium carbonate were found to be entirely inert as energizers.

2. The Cyanide Theory. When nitrogen comes into contact with a hot mixture of carbon, iron and sodium, potassium or barium carbonate, cyanides are formed. This reaction is the basis of the Bucher process for fixing atmospheric nitrogen. Since cyanides are powerful carburizers, some investigators concluded that the energizing power of sodium and barium carbonate was due to the action of cyanides formed from the atmospheric nitrogen entrapped in the retort. However, as reported by Giolitti,[2] it was proven that no trace of cyanides could be detected in the gases evolved from the carburizing retort, or in the used carburizing compound. The cyanide theory has definitely been abandoned.

3. The Cyclic Reactions of Fetchenko-Tschopiwskij. In Fig. 3 is a reproduction of the reactions proposed by Fetchenko-Tschopiwskij[26] to explain the energizing effect of barium carbonate and potassium carbonate. The important thing to note is the cyclic character of the reactions in which the energizer participates. Although his proposal represents a marked advance, the actual kinetics of the process are not adequately presented. Furthermore, though the formation of potassium vapor is indicated, it is regarded as playing no part in the energizing effect.

4. Takahashi's Theory. The following theory has been proposed by Takahashi.[27]

1. At the carburizing temperature, the carbonate starts to dissociate according to the reaction $MCO_3 \longrightarrow MO + CO_2$.
2. The carbon, which is the predominating component of the carburizing agent tends to establish the equilibrium gas composition demanded by the reaction $C + CO_2 \rightleftarrows 2CO$.
3. The carbon monoxide in the gaseous phase reacts with the metallic oxide liberated in step 1, according to the reaction $MO + 2CO \longrightarrow MCO_3 + C$.
4. The carbon precipitated in step 3 is in finely divided form and reacts directly with the steel.

According to Takahashi, the carbonate undergoes repeated dissociation and regeneration with an accompanying production of a large amount of finely divided carbon which is available for absorption by the steel.

A complete discussion of Takahashi's paper is prohibitive, but 2 objections to his theory may be mentioned. (1) One of the essential features in the proposed theory is a partial *direct* decomposition of the carbonate. Table 1 gives the minimum temperatures at which various carbonates can undergo direct decomposition in the presence of carbon. Yet it is known that materials such as sodium carbonate and barium carbonate are very active energizers at temperatures below those indicated in Table 1. (2) The theory proposed does not explain in a satisfactory manner the ineffectiveness of calcium carbonate. It is known that calcium carbonate will dissociate directly at carburizing temperatures. Takahashi presents data showing that when carbon monoxide is passed over calcium carbonate, a dense deposit of carbon is produced. Hence, according to his theory, calcium carbonate should act as an energizer, yet it is inert.

THEORY PROPOSED BY THE AUTHORS

Some specific cases of catalysis may be explained by the formation of an intermediate unstable compound which acts as a carrier between the reactants. Thus, it might be proposed that the energizing action of certain carbonates is due to the formation of carbides which act as carriers of carbon. However, there are objections to accepting such a theory. (1) The carbides in question are formed only with difficulty and at temperatures far above those employed in the carburization of steel. (2) Barium carbide is a very weak energizer as compared to barium carbonate.[1] The theory of the formation of intermediate carbides was therefore abandoned as untenable.

In discussing the mechanism of carburization, it was pointed out that one of the essentials of the carburizing process involved the regeneration of carbon dioxide according to equation (2). The reaction between carbon dioxide and carbon is known to be rather slow, and it is known that certain materials have a decided catalytic effect upon the reaction. In reviewing the literature on catalysts for the $C:CO_2:CO$ reaction, it was noted that there was a parallelism between the compounds that were effective catalysts for the $C:CO_2:CO$ reaction and those that were effective energizers in the carburization of steel.

Boudouard[28] found that finely divided iron, nickel and cobalt produced by the reduction of the corresponding nitrates were effective in accelerating the $C:CO_2:CO$ reaction. The writers[1] have found that oxides and carbonates of these metals (which will be reduced to the metallic state at the carburizing temperature) exert a definite energizing effect in the carburization of steel. Taylor and Neville[29] found that the $C:CO_2:CO$ reaction was catalyzed by sodium carbonate, potassium carbonate and nickel, but that ferric oxide, calcium carbonate and sodium chloride were ineffective. The parallelism is not exact here, as the authors found that ferric oxide and sodium chloride had distinct energizing effects. However, Taylor and Neville worked at a maximum temperature of 1058° F. (570° C.) which is considerably below tempera-

tures used in carburization. Fox and White[17] found the accelerating effect of sodium carbonate on the $C:CO_2:CO$ reaction to be very pronounced. It is well known that sodium carbonate is a very active energizer.

We propose that *the energizing action exerted by certain chemicals in the carburization of steel is primarily due to the catalytic effect produced upon the $C:CO_2:CO$ reaction.* This proposal will be developed in some detail, considering sodium, potassium, barium, strontium, calcium and magnesium carbonates and various other compounds.

1. Sodium and Potassium Carbonates. The following discussion is largely based upon the work of Fox and White[17] on the mechanism of the catalytic effect by sodium carbonate on the $C:CO_2:CO$ reaction.

At the surface of the carbon, the following reactions occur.

$$Na_2CO_3 + C \longrightarrow Na_2O + 2CO \quad (7)$$
$$Na_2O + C \longrightarrow 2Na + CO \quad (8)$$

The available data indicate that the sodium is evolved with considerable pressure, hence the products of the reaction at the carbon:gas surface are projected outward into the gaseous phase.

The carbon dioxide formed at the steel:gas interface by the reaction of the carbon monoxide with the steel combines with the sodium according to the following reaction

$$2Na + CO_2 \longrightarrow Na_2O + CO \quad (9)$$

If the partial pressure of carbon dioxide in the particular region where a sodium oxide molecule is formed is higher than the carbon dioxide pressure of sodium carbonate, further absorption of carbon dioxide from the gaseous phase will occur, thus:

$$Na_2O + CO_2 \longrightarrow Na_2CO_3 \quad (10)$$

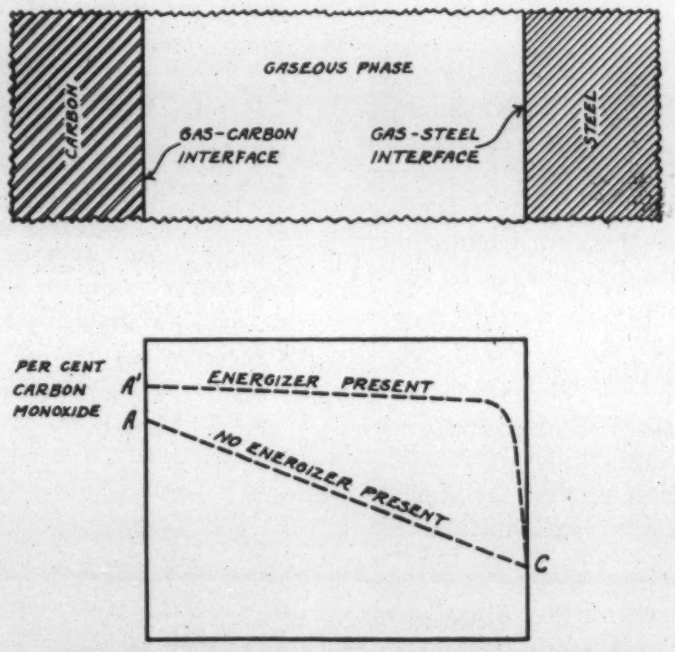


Fig. 4. Schematic Sketch to Illustrate Energizing Effect of Sodium or Potassium Carbonate.

The sodium oxide and sodium carbonate formed according to equations (9) and (10) condense and fall upon the carbon surfaces. The cycle described is repeated many times.

The effect that these reactions would have upon the concentration gradients in the gaseous phase are depicted in a qualitative way in Fig. 4. The lower curve (A-C) illustrates the carbon monoxide gradient in the gaseous phase between a carbon particle and the steel surface, when no energizer is present. The upper curve (A'-C) illustrates the conditions when sodium or potassium carbonate is present with the carbon.

The sodium formed as vapor at the carbon:gas interface and projected out into the gaseous phase acts as a highly efficient scavenger for carbon dioxide. The carbon monoxide concentration at the carbon:gas interface is increased due to reactions (7) and (8). The net result is that a high carbon monoxide concentration is established in the main mass of the gaseous phase, and there will be a sharp drop in carbon monoxide concentration in a film of gas adjacent to the steel. This extremely high concentration gradient will result in a greatly accelerated rate of carbon monoxide transfer to the steel surface, and hence carburization will be speeded up.

2. Barium and Strontium Carbonates. At the point of contact with the carbon, the following reaction occurs

$$BaCO_3 + C \longrightarrow BaO + 2\,CO \quad (11)$$

Unlike sodium or potassium oxides, the barium oxide will not be reduced to the metallic state at the temperatures used in carburizing. The direct interaction of carbon and the carbonate will tend to increase the carbon monoxide concentration in the main mass of the gaseous phase beyond that demanded by the $C:CO_2:CO$ equilibrium.

In contrast with sodium and potassium carbonates, there is no metallic vapor evolved from barium or strontium carbonate, which when introduced into the gaseous phase acts as a scavenger for carbon dioxide. However, as Table 2 shows, the partial pressure of carbon dioxide in equilibrium with barium oxide is very low. Hence, the absorption of carbon dioxide from the gaseous phase will be more rapid than if the carbon dioxide were required to combine with the carbon. The net result of these effects is toward the establishment of the conditions depicted by the upper curve of Fig. 4.

3. Calcium and Magnesium Carbonates. The inactivity of calcium and magnesium carbonates is readily explained. Above 1335° F. (724° C.), calcium carbonate exerts a carbon dioxide pressure greater than that demanded by the $C:CO_2:CO$ equilibrium. Therefore, calcium carbonate will decompose directly in the presence of carbon at temperatures ordinarily used in carburization. The carbon dioxide pressure of calcium carbonate is very high (1690 mm. at 1750° F.), hence decomposition is rapid, and probably is complete by the time the carburizing temperature is reached. The carbon surfaces are coated with calcium oxide, but the latter cannot react with carbon to form carbon monoxide. Furthermore, the calcium oxide cannot absorb carbon dioxide from the gaseous phase due to the extremely high decomposition pressure of calcium carbonate. Therefore, the cyclic reactions described for sodium, potassium, barium and strontium carbonates cannot take place, and as a result, calcium carbonate is ineffective as an energizing agent. Magnesium carbonate is inactive for the same reasons.

4. Other Sodium Compounds. The authors[1] have shown that sodium carbonate, bicarbonate, hydroxide, acetate, oxalate, cyanide, chromate and tungstate are approximately equal in effect as energizers at 1750° F. (954° C.), when the carburizing agents are all so proportioned that there is the same ratio between the weight of charcoal and the weight of sodium. This result supports our proposed theory, when consideration is given to the changes that occur in the various compounds on heating in the presence of carbon. Sodium bicarbonate on being heated is decomposed into sodium carbonate, carbon dioxide and water, and hence, should be the equivalent of sodium carbonate. When sodium hydroxide is heated, water is driven off and sodium carbonate and sodium oxide will be formed. Organic compounds such as acetates, oxalates, etc., will yield sodium oxide, sodium carbonate and various gases. The gases evolved by the destruction of the organic radical do not appear to have an appreciable effect supplementary to that exerted by the sodium oxide and carbonate formed. Sodium cyanide likewise forms sodium oxide and carbonate, and at the same time cyanogen is evolved. This gas does not appear to intensify the energizing action of the liberated sodium oxide and carbonate. When sodium tungstate and chromate are heated, all of the sodium

appears to be converted into oxide and carbonate, as the energizing effect is approximately equivalent to sodium carbonate; the tungsten and chromium components of the respective compounds appear to be inert.

Other compounds of sodium, such as the chloride, the phosphate, the borate, etc., show reduced activities as compared with the carbonate. It appears that for these compounds the negative radical exerts an inhibiting effect, probably by preventing the conversion of all of the sodium into oxide and carbonate. In some instances, as with sodium sulphate, stannate and bismuthate, the lowered activity is due primarily to attack of the steel or deposition of reduced metal on the steel.

5. Other Potassium Compounds. Potassium carbonate, bicarbonate, hydroxide, acetate, oxalate, tetroxalate, cyanide, ferricyanide, ferrocyanide, chromate, dichromate and permanganate are all approximately equal in energizing effect at 1750° F. (954° C.), when the carburizing mixes are proportioned to have the same ratio by weight between charcoal and potassium. This equivalence gives further support to our theory. Compounds other than those mentioned show reduced activity, but many of them still exert a marked effect.

6. Other Barium Compounds. Barium carbonate, oxide, hydroxide, acetate and nitrate all yield approximately the same result at 1750° F. (954° C.) when the carburizing agents are so proportioned that a definite ratio by weight exists between the charcoal and barium. This is further evidence in support of the proposed theory. Compounds other than those mentioned show reduced activity. In these instances, it appears that some barium oxide is formed, but the negative radical prevents the complete conversion of barium to oxide and hence exerts an inhibiting effect.

7. Other Calcium and Magnesium Compounds. A variety of calcium and magnesium compounds are inert as energizers. In view of the explanation offered for the ineffectiveness of calcium and magnesium carbonates, this result is what would be predicted.

8. Compounds Other Than Those of the Alkali and Alkaline Earth Metals. Ferric oxide, ferrous carbonate, nickel oxide, basic nickel carbonate, cobalt oxide, cobalt carbonate, cobalt nitrate, tungstic acid, molybdic acid and ammonium molybdate exert distinct energizing effects.

It might appear that the positive results obtained with ferrous carbonate, basic nickel carbonate and cobalt carbonate are not in accordance with the proposed theory. These carbonates decompose very easily and the metallic oxide is reduced to metal. Thus the cyclic reactions taking place with sodium, potassium and barium compounds do not take place with iron, nickel and cobalt carbonates. However, it must be remembered that the explanations offered for sodium, potassium and barium carbonate are but special cases of the general theory proposed, namely, that *any substance capable of acting as a catalyst for the $C:CO_2:CO$ reaction will act as an energizer in the carburization of steel.* Boudouard[28] has shown that reduced iron, nickel and cobalt act as catalysts for the $C:CO_2:CO$ reaction, hence it is to be expected that any compound of iron, nickel or cobalt which will be reduced to the metallic state under the conditions of carburization, will act as an energizer. While in the cases of sodium, potassium and barium carbonates it is possible to describe quite satisfactorily the *way* in which the $C:CO_2:CO$ reaction is accelerated and hence carburization speeded up, it is not possible to do so for reduced iron, nickel or cobalt.

No data are available on the effect of tungsten and molybdenum compounds on the $C:CO_2:CO$ reaction, but in view of the fact that they exert an energizing action in carburization, it might be predicted that they will catalyse the $C:CO_2:CO$ reaction.

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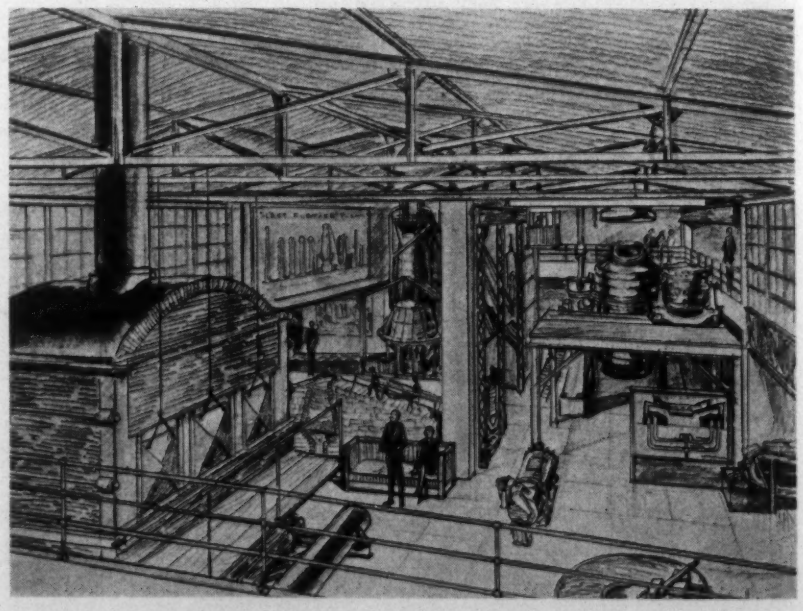


View of Proposed Hall of Metallurgy in the Museum of Science and Industry, Chicago.

A metallurgical extension class, the first of its kind to be organized by the Mineral Industries Extension Division of Pennsylvania State College, was formed last week at the Altoona shops, Pennsylvania Railroad. The class is composed of 25 men, consisting of chemists and engineers of tests.

The work to be covered will consist of the metallurgy and metallography of ferrous and non-ferrous alloys and bearing materials. Considerable stress will be laid on the examination of failures in track and equipment materials. Dr. D. F. McFarland, Prof. O. A. Knight and Prof. O. B. Mallin will teach the several subjects.

A Photographic Creep Testing Apparatus

BY D. A. ROBERTS* AND R. L. DOWDELL**

DURING the past few years various types of apparatus have been developed for determining the flow or creep of metals at elevated temperatures. The general procedure in a creep test consists in the loading of a specimen to produce a desired stress, usually the heating of the specimen at a constant temperature, and reading the resulting flow at desired intervals of time.

The design of various creep testing equipment varies widely in detail, but the basic principles involved in the heating and loading of the specimens are all quite similar. In general, the furnace, with its specimen holders, is mounted in a suitable steel frame, and the load applied through the specimen holders by means of dead weights acting through a lever system, or in the case of small loads by direct loading. The use of knife edges on the lever arms appears to be the most common practice, and in the case of apparatus employing very sensitive flow measuring devices, spring mounting for the frame to absorb vibration is employed.

The furnaces used for this type of work are of the resistance wire type. The windings are spaced so as to produce as uniform a temperature over the entire specimen as possible. End windings, uniform windings with auxiliary coils, and irregular spaced winding with most of the wire at the ends of the furnace are the general types in use. Furnaces of relatively small diameter and with a rather large ratio of length to diameter are preferred by most investigators. An individual controller for each furnace is frequently used, and the temperature automatically recorded within close limits.

The flow or creep measuring devices fall into three general classes: those using extensometers similar to the type used in ordinary tensile testing work; those in which the elongation is measured externally by means of dials operated by the movements of the loading lever arms; and those employing microscopes mounted on micrometer slides which sight through the furnace on to the gage marks of the specimen.

The creep test apparatus constructed at the University of Minnesota differs from other creep test apparatus in that a photographic method is used for determining the flow of the test specimen shown in Fig. 1. Briefly, this method consists in photographing the gap formed between a platinum wire and a platinum strip attached to a wire, the wires being located 2 inches apart on the gage length of the test bar. As the bar elongates the width of the gap, as shown in Fig. 2A, increases and photographs taken at desired intervals of time (Fig. 2B) show a record of the flow. The resulting photographic plates (lantern slides—negatives) projected through a lantern on to a screen produce any degree of magnification of the object or gap that is desired. The determination of the magnification was originally made by photographing a stage micrometer in exactly the same position as that occupied by the specimen (Fig. 3), and projecting the resulting plate in the same manner as mentioned previously. In future work, however, a "graduating engine" will be used to mill lines spaced accurately on the metal strip so that it will replace the stage micrometer. Each photographic plate will then indicate the exact magnification and so will be largely independent of the rest. This modified method will also be more accurate because the distance between the specimen and lens can undergo a slight variation without affecting the accuracy of the elongation measurements.

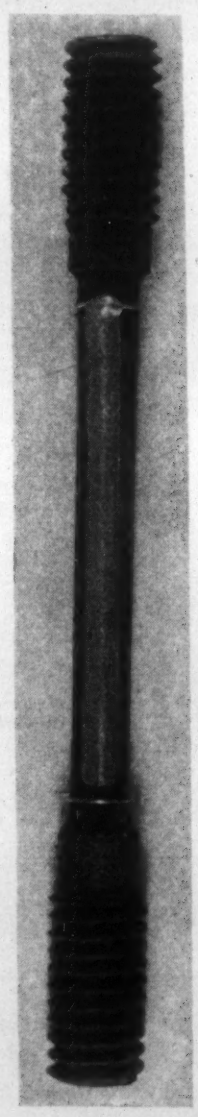
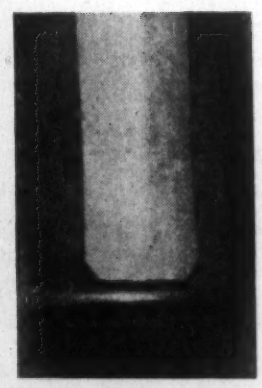


Fig. 2. Photograph of test bar with platinum wire and strip attached:

2A, natural size. ←



2B, magnification 4×. Print from negative used for projection in lantern to 100 diameters.

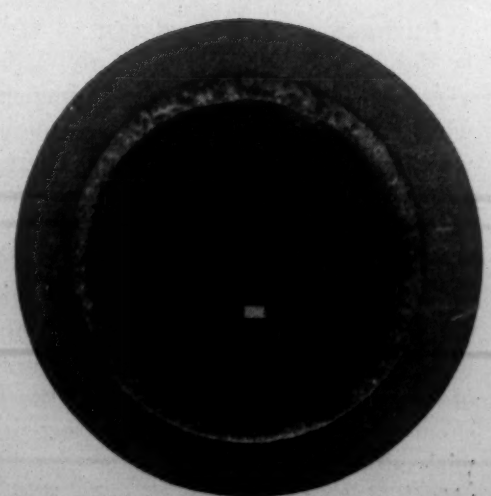


Fig. 3. Photograph of stage micrometer for determining magnification.

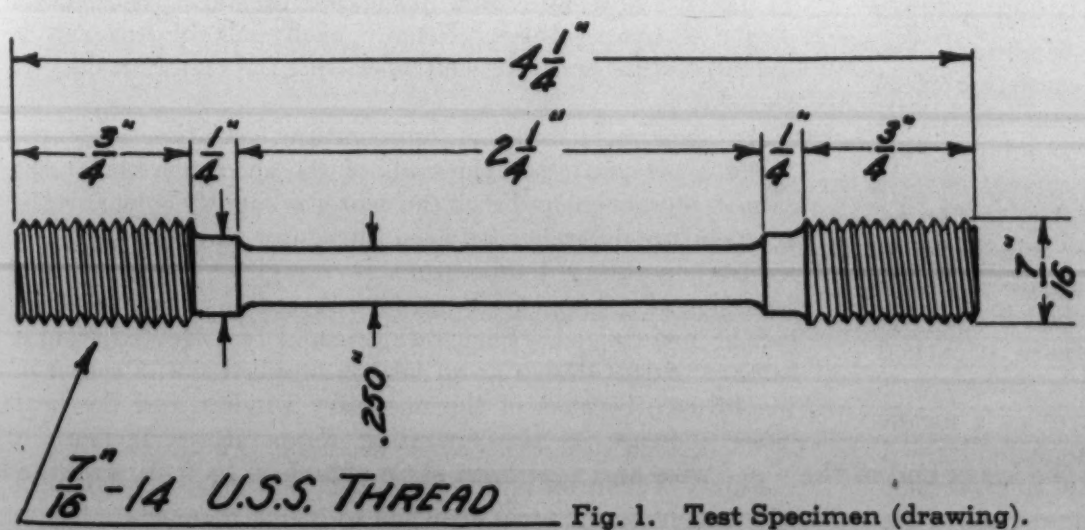


Fig. 1. Test Specimen (drawing).

* Graduate Student. This paper was condensed from a thesis "An Apparatus for Determination of the Flow of Metals at Elevated Temperatures" submitted to the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science, in Metallography, Minneapolis, Minnesota, June 1931.

** Professor of Metallography, University of Minnesota.

General Form of Apparatus. The general assembly of the creep apparatus is shown in Fig. 4. It contains four test units and is built of steel angle and channel sections of welded construction to ensure the utmost rigidity. The design of the frame is such that the deflections resulting from loading are exceptionally small. The specimen holders are of stainless steel rods of 1 inch diameter having the following composition: 18% Ni, 8% Cr and 4% W. This material was selected because it does not scale at the temperatures used, has a high tensile strength at elevated temperatures and has about one-third the thermal conductivity of ordinary steel. Steel balls, seated between the frame and upper holder connection, aid materially in axially loading of the test bars. Steel yokes provided with pins connect the lower specimen holders to the lever arms (Fig. 4). The length of the upper holders is sufficient to allow the furnaces to be raised high enough to expose the entire specimen for any necessary adjustments.

The stress is applied to the specimens through lever arms of 5 to 1 ratio by the reaction of dead weights on bail boards. The levers are assembled by means of pin connected joints and can be leveled by means of the threaded eyebolts. A calibration of the pin connected joints used in place of the customary knife edges at high loads showed a friction loss of less than 0.20%. For small stresses the lower specimen holder can be loaded directly thus eliminating all error which might result from the lever system.

The lever arms were calibrated by placing known weights on the bail boards and weighing the reaction produced at the specimen holder with (Howe) platform scales weighing directly to 0.01 lb. The weight at the specimen holder was then compared with the product of the weight on the bail board and the lever ratio. Any difference in the two would be considered as the friction loss. The following tabulation from some of the figures from one of the units shows how the frictional loss is determined.

Weight on Bail Board × Lever Ratio Lbs.	Weight on Specimen Holder Lbs.	Difference Lb.
100.8	100.68	0.12
350.23	350.08	0.15
599.20	598.05	1.15

The load produced by the reaction of the weight of the lever arm was found to be 32 pounds for each unit because the bail boards and levers were all adjusted so as to be of the same weight.

Furnace. A cross section of the furnace used as shown is Fig. 5. The furnace is built around an alundum core of $1^1/_4$ inches inside diameter, 12 inches in length, and provided with helical grooves for the spacing of the windings. The windings are divided into two parts, each consisting of 25 feet of 16-gage nichrome wire. The windings are symmetrically spaced with respect to the test bar. Granular zirkite, held in place by asbestos paper and alundum cement, is used to surround the heating coils. This material is highly refractory and does not react with the furnace winding thus insuring long furnace life. The ends of the furnace are made of $^1/_2$-inch "transite" discs and the furnace shell is made of sheet iron. The remaining space in the furnace is packed with sil-o-cel. A steel collar provided with a set screw is attached to the upper transite disc and serves as a means of fastening the furnace to the upper specimen holder. A window for observing the elongation or creep of the specimen is cut into the furnace at a point opposite the lower end of the test bar. This opening is rectangular in shape and its height increases as it extends to the outside to allow the admission of light for illumination of the test bar.

Fig. 4. Photograph of 4-unit Creep Apparatus.

The furnace is automatically controlled by a Wilson-Maeulen controller, the control thermocouple being located in direct contact with the furnace winding. The temperature of the test piece is recorded by means of a Bristol recorder. In this case the thermocouple is attached directly to the shoulder of the test bar, by simply wiring on the hot junction after flattening the bead so as to allow it to conform with the contour of the specimen. Hoskins Chromel-Alumel couples of No. 22 gage (bare) were used in connection with a Leeds-Northrup Potentiometer Indicator for checking the actual temperature of the furnaces and regulating the setting of the controller. While the manual checks for temperature were not being made the Bristol recorder was in service and was used primarily to show the general weave of temperatures. Usually each pair of furnaces is operated by a separate controller with the aid of an outside rheostat.

An exploration of the temperature variation over the specimen showed that the ends of the specimen run at the same temperature and that the center is slightly colder. The temperature difference between the center and ends increases as the operating temperature is raised. Control with a variation of not over 5° F. at 800° F. and 10° F. at 1400° F. can be maintained. Such results could be expected from a furnace of this design as no heat is supplied at the center of the furnace because of the necessary window and the heat losses increase as the operating temperatures increase.

Flow Measurement. The test bar has a platinum wire and platinum strip attached to it in a manner similar to

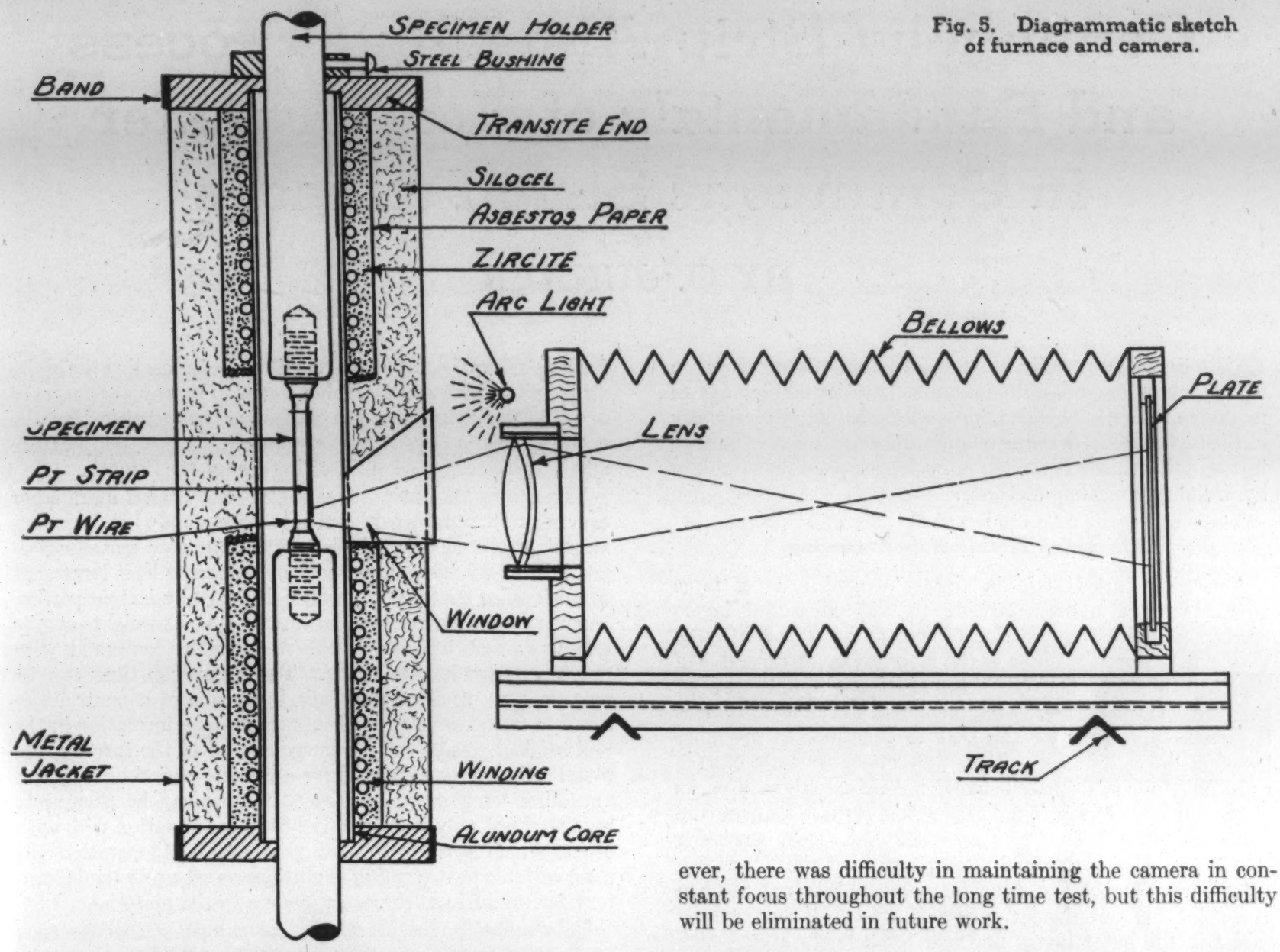


Fig. 5. Diagrammatic sketch of furnace and camera.

that developed by Spring and Kanter[1] (Fig. 2). It was found that a thin strip with a square end along with a fine wire gave the best results. The strips used were 0.006″ thick, $^3/_{16}$″ wide, and were bent to fit the contour of the test bar. A bent strip possesses stiffness and resists any tendency to curl or distort. The wire used was 0.018″ in diameter. As platinum has a low coefficient of expansion, the wires hold their places as the test bar is heated. A slight scaling of the bar also tends to hold the gage wires in place.

Camera. The camera used for this work is a Bausch & Lomb equipped with a 72 mm. micro-tessar lens. The camera is mounted in a frame which allows the lens and plate holder to be adjusted separately. The camera frame slides on a track so that it may be moved to the various furnaces.

Illumination of the test specimen is provided by means of a 5 ampere carbon arc mounted in a suitable holder above the camera lens. Light from the arc enters the furnace through the window previously described (Fig. 5).

Determination of Creep. Photographs are usually taken of the gap between the platinum wire and platinum strip at various intervals of time. The usual magnification is four diameters. Lantern slide plates made by Eastman were used, mostly with an aperture setting of 16 and a time of exposure of about 45 seconds. These negatives are then projected in any projection lantern and usually magnified to 100 diameters. At this magnification the 0.10 mm. divisions on the stage micrometer appear 1 cm. apart on the screen. As it is possible to read the projected image to the nearest millimeter, direct readings of 0.01 mm. or 0.00039″ are obtained.

Sufficient work has been done with this equipment to indicate strongly that it has merit. In the early work, however, there was difficulty in maintaining the camera in constant focus throughout the long time test, but this difficulty will be eliminated in future work.

Main Features of Apparatus:

1. The flow readings are taken directly on the gage length of the specimen and are independent of any deflections that may occur in other parts of the apparatus.
2. The measuring apparatus is not subjected to the heat inside the furnace.
3. A permanent record of the flow independent of personal error in the results.
4. Capable of greater accuracy on measurements of elongation.
5. Records any change which specimen and indicating strip and wire might undergo during the long time tension test.

The writers are grateful to Mr. John L. Cox of the Midvale Company for the generous contribution of the stainless steel grips and also to Mr. Wm. Kahlbaum, formerly Research Associate at the Bureau of Standards, for his suggestion of a possible creep apparatus involving a photographic principle.

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Nassau Smelting & Refining Company, Inc., successor to The Nassau Smelting & Refining Works, Ltd., Tottenville Copper Company, Inc., and Argus Smelting Company announces that the executive, sales and purchase offices will be located at 50 Church Street, New York.

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A decision in favor of the United Chromium Company, Inc., was filed in the United States District Court by Judge Edwin S. Thomas.

The suit in equity charged the International Silver Company of Meriden with infringement of patents relating to chromium plating processes. The decision directs an injunction, reference and accounting of damages and profits.

[1] *Proceedings American Society for Testing Materials*, Vol. 28, Part II, 1928, page 80.

Continuous Strip Annealing Process and Fundamentals of Heat Transfer in Continuous Strip Furnaces*

BY O. JUNKER

Strip metals, especially brass and copper strip, are used in automatic or semi-automatic machines for making drawn metallic articles. This demands a strip having a uniformity of the highest deep drawing quality and smoothness of surface in the finished article, which is no longer possible to obtain by ordinary annealing methods.

Difficulties in Uniformly Annealing

Annealing closed strip in tightly wound coils of large weights causes uneven heating in the individual layers corresponding to the direction of heat flow. The heat flows very slowly from the outer to the inner layers, irrespective of the strip thickness, because of the resistance to heat transfer between each sheet layer, the total of which in all layers makes it extremely difficult for the heat to penetrate to the inner layers of the coil. Observations were made by Roth[1] of such resistance to heat transfer between individual layers in packs of brass sheet. It was found that with a furnace temperature of 550° C., the top sheet of a pack 500 mm. thick, consisting of 0.7 mm. sheets, attained a temperature of 450° C. within $1^1/_2$ hours, whereas the same temperature was not reached at a point 300 mm. deeper until $6^1/_4$ hours. Therefore, the sheets in the outer layers are held for 5 hours at the high temperature between 450° and 530° C. while the inner sheets have hardly attained the annealing temperature during the same interval. These differences in the heating of the individual sheets manifest themselves in corresponding uneven deep drawing properties and variations in grain size, or the surface quality of articles drawn from the sheets. These conditions are similar in a heavy coil of strip which is annealed as such.

The Continuous Strip Furnace

These difficulties led to the development of the so-called continuous strip furnace, through which the material to be annealed passes in a single strip. The continuous strip furnace[2] offers the theoretical possibility of annealing the entire strip uniformly over its whole length. For any one material and the same furnace, the annealing temperature for the entire length is dependent only on the furnace temperature and the speed of travel of the strip through the furnace.

The continuous strip annealing process entails more labor expense, but on the other hand not only insures a homogeneous anneal of the entire strip but opens up new metallurgical possibilities by providing especially favorable heat treatment conditions for the strip to produce definite physical properties. The very large surface area with respect to its weight permits extremely fast heating of the metal strip compared with previous annealing methods. The annealing time can be measured accurately in seconds by means of a controllable speed of travel. By providing suitably long insulation in the unheated or weakly heated outgoing end of the furnace, the metal strip can be tempered for a definite period of time and annealing temperature. These 3 factors can be accurately regulated not only individually but in combination with each other, which permits obtaining in practical operation the most suitable heat treating conditions as set up in the laboratory for producing definite properties in the material.

Unfortunately, for practically all metals and alloys such special heat treating conditions are not available because of a lack of stimulation in the industry heretofore. The industry has not demanded such close tolerances for the heating conditions simply because there existed no possibility prior to the continuous strip furnace for performing such annealing under practical conditions.

An example of the possibilities in controlling the annealing temperature by varying the speed of travel is shown in a test made with brass strip—0.2 × 30 mm.—for snap fastener manufacture.

The copper content of this strip was 61%. The furnace temperature was 800° C. The strip was first passed through with a speed of 6.5 meters per second. With this speed a very excellent deep draw value (Erichsen Test) was obtained,

* Translated from *Zeitschrift für Metallkunde*, Vol. 23, April 1931, pages 124–125, by William Adam, Jr., Vice-Pres., Ajax Electric Co., Inc.

[1] *Zeitschrift für Metallkunde*, Vol. 21, 1929, page 414.

[2] Tama, *Zeitschrift für Metallkunde*, Vol. 21, 1929, page 77.

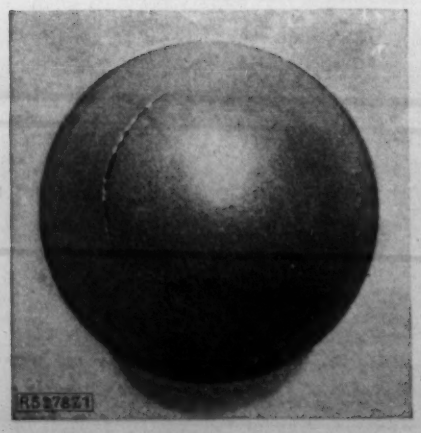


Fig. 1.—Deep Drawn Test on Brass Strip (61% Cu).

Fig. 2.—Structure of Test in Fig. 1 —80 dia.

v = 6.5 m./min., t = 8.4 Actual t = 7.1 specified.

Fig. 3.—Deep Drawn Test on Brass Strip (61% Cu).

Fig. 4.—Structure of Test in Fig. 3 —80 dia.

v = 5.0 m./min., t = 7.3 Actual t = 7.1 specified.

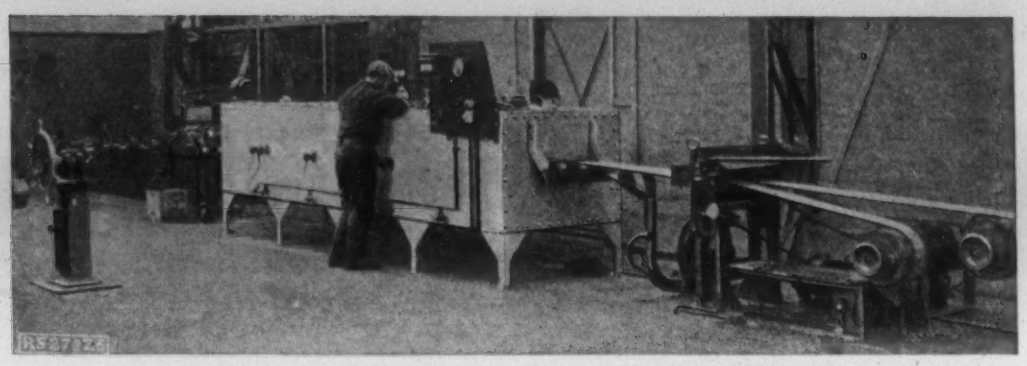


Fig. 5. Continuous Strip Annealing Installation.

considering the low copper content. This was t = 8.4 mm. whereas the specified value was 7.1 mm. Furthermore, the cup of the ball was very smooth as is clearly shown in Fig. 1.

The microscopic structure shows a very fine grain. Due to the low copper content, it consists of about the same parts of α and β-crystals. Fig. 2 shows a line structure due to the rolling stresses.

The same test was then made with a strip speed of 5 meters per minute. The resulting anneal is entirely different from the previous one. Not only did the deep draw value recede (Erichsen), but the cup drawn by the ball was very rough—Fig. 3.

Apparently the temperature rose to a point where the brass was in the range of pure β-crystalline mixture. This caused the formation of large polygons, which on subsequent cooling were mixed by the separation of needle shape α crystals. The creation of the large β-polygons produced a particularly coarse grain structure as compared with the first annealing results.

In Fig. 4, which has the same magnification as Fig. 2, these polygons cover approximately half the area.

It would be interesting to investigate the dependence of deep-drawability (measured by the Erichsen Test) and the grain size on the rate of heating and time of annealing at a definite temperature, and on the cooling rate of the strip or sheet, for a number of metals—above all for the commonly used deep drawing brasses and copper.

Recognizing the advantages of the continuous strip annealing furnaces for brass, copper, nickel-silver and aluminum, several of the larger German mills have already placed such continuous strip furnaces in successful operation. (See Tama, *Zeitschrift für Metallkunde*, Vol. 21, Mar. 1929, pages 77-86.) Fig. 5, shows an electrically heated continuous strip furnace, having a production of 6 tons in 24 hours.

The material annealed in this furnace shows such improved quality with reference to the uniformity of anneal and highest deep drawability with a fine grain structure, that the somewhat higher labor cost has been over-balanced many times.

Furthermore, the labor cost may be considerably reduced in the continuous strip annealing process, by combining the pickling, washing and drying operations. A layout for this is shown in Fig. 6.

Most continuous strip furnaces are being built for electric heating. Electric heat has the advantage of an accurate and simple temperature regulation required for the continuous strip process. In using electrical energy for the heat source in such furnaces, the highest possible efficiency must be obtained. The elongated shape of the continuous strip furnace stipulates undesirable heat losses from the furnace shell to the surroundings. By proper design of such electrically heated continuous strip furnaces, i. e., provision for good insulation and heat transfer, these units have to-day been brought to a thermal efficiency as great as 80%, so that the power consumption, for example, for 1000 kg. brass strip is 80 kwh. This extremely good efficiency can be obtained in a furnace as shown in Fig. 5.

The strip hangs in the furnace in a catenary form. This arrangement is essential in order to prevent scratching of the surface on the strip. The hang of the strip in the furnace is controlled accurately from the inlet side as shown by the circuitous roll arrangement in Fig. 6. This works in the following manner: by means of the first fixed bending roll the strip is given a definite tension in passing through the furnace and over the guide rolls on the other side of the furnace. This tension is then further accurately regulated by means of a second movable bending roll by means of counterweights.

The electrical heating element wires are fastened directly in the chamber walls. The chamber walls are about 30 mm. thick and made of a special cement having good heat conductivity in order to prevent heat storage in the chrome-nickel heating elements. The wires are wound in a spiral, and are divided over the entire heated length of the furnace so that

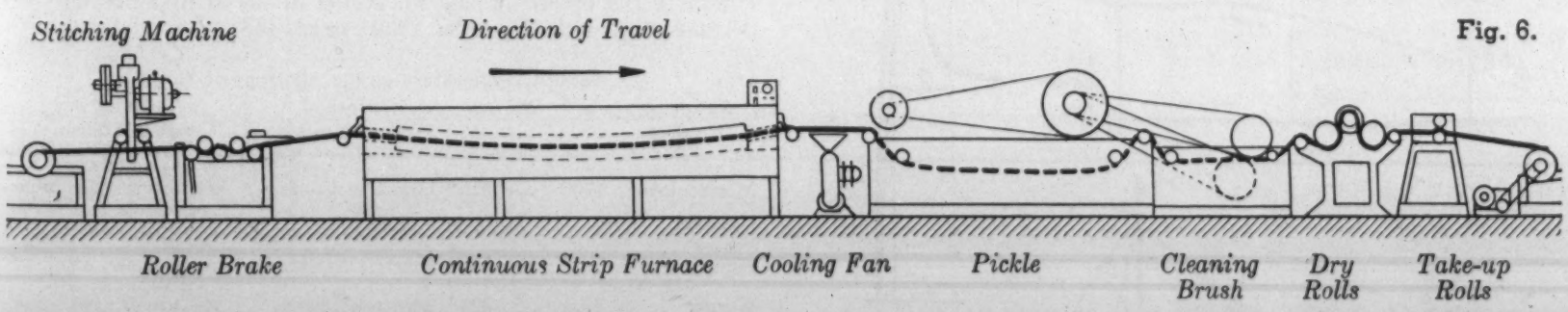


Fig. 6.

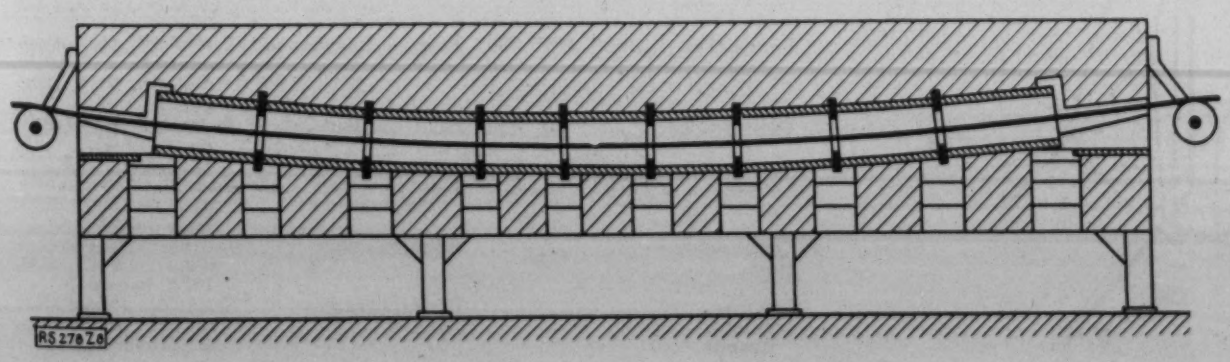


Fig. 7. Furnace Details. The muffle wall, about 30 mm. thick, is of burned special refractory with good heat conductivity, which avoids heat storage in strip. Powdered insulating material fills space between inner heating tube and outer shell.

the energy input per unit of furnace length is greater at the inlet side than at the outlet side. They are also arranged in various zones so that they can be disconnected at will.

By placing the heating elements directly in the chamber walls, a more simple chamber construction is obtained and also makes it possible to provide the best insulation for the furnace. The muffles are supported on the ends by insulating bricks. The remainder of the space between outer steel casing and the inner heating chamber is simply tamped with a good insulating powder. Since the heat conductivity of the best insulating powder compared with the best insulating brick bears the following relation.

$$\lambda = .1 \text{ k cal/mh } ^\circ \text{C. to} = .3 \text{ k cal/mh } ^\circ \text{C.}$$

at the temperatures in question, it can readily be seen that the insulation of this type furnace is good. For instance, with a furnace 4.5 meters long and a useful width of 500 mm. in the heating chamber the power required for holding the furnace at a temperature of 750° C. is only 3.5 kw.

◆ ◆ ◆ ◆ ◆

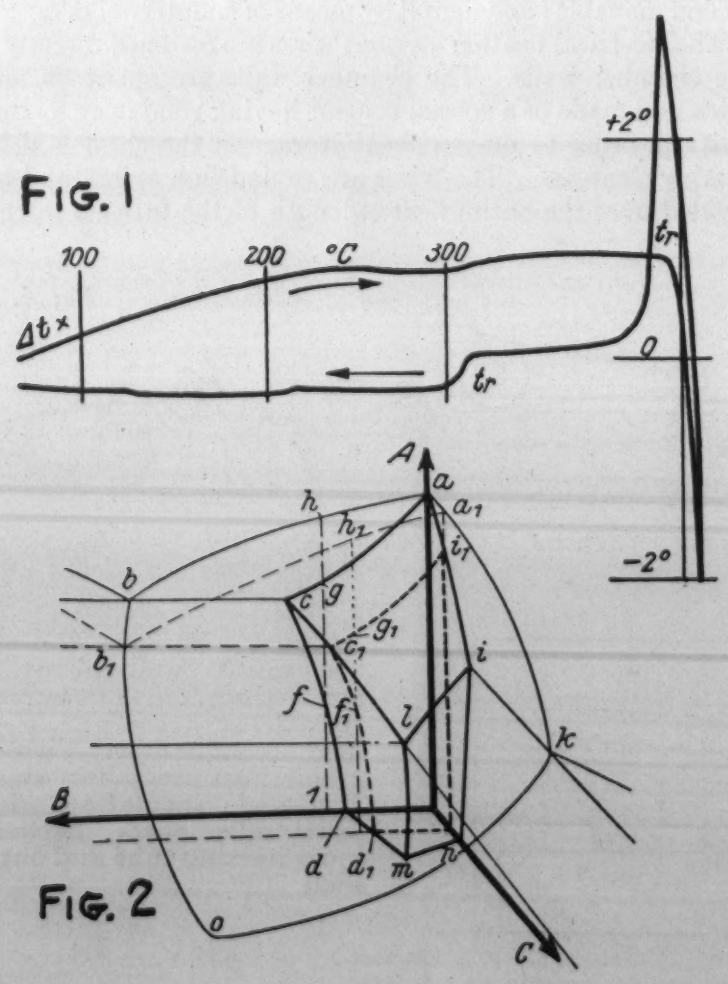
The Polymorphism of Zinc

BY L. ANASTASIADIS AND W. GUERTLER

THE different results obtained by earlier investigators of the polymorphism of zinc have induced us to make further researches concerning the allotropy of zinc with the help of thermal analysis (Saladin apparatus, double mirror galvanometer).

For this research we used 99.999% zinc. The differential-galvanometer was calibrated for the highest sensitivity of ± 2° C. Each degree corresponded to 20 mm. on the silver bromide paper. A difference in temperature of 0.02° C. between the material under test and the comparison material displaced the straight line course of the curve 8 mm. on the silver bromide paper. The heating and cooling were done very slowly. Each trial required about seven hours.

Fig. 1 shows that there is no discontinuity on the heating or cooling curve. At the point *tr* the curve shows a kink, this is due to an intentional variation of temperature. According to these measurements there exists no transformation point of zinc. Now the question is how this result is comparable with the results of earlier investigators who had very evidently found the thermal effect, and indeed each investigator found different temperatures and different intensities. In our opinion it can not be doubted that these apparent transformation points of zinc were caused by impurities in the material tested. This consideration gains weight when we consider that the highest solubilities of the different impurities present in the zinc crystal are very low and therefore a small displacement of the proportion of impurities brings with itself a great dislocation of the temperature curves for the solidus and the segregation-curve of the solid solution. For a further explanation see Fig. 2.



The right corner in the back of the system of coördinates corresponds to the constituent *A* (zinc). In regard to the 2 impurities *B* and *C* their proportions are drawn in on the other axis in the direction of the arrows. With the addition of *B* to *A* we have the liquidus line *ab*, the solidus line *ac* and the segregation-curve *cd*. An impurity of the zinc with as much as *B* the point 1 indicates would cause in addition to the lowered freezing point *h* two thermal effects, *f* and *g*. With a decrease in the proportion of *B* they become more removed from one another, by raising the concentration of *B* they were brought nearer to one another until they coincided at the temperature of the horizontal *bc*. If the alloys are not in equilibrium then an impure zinc of the composition 1 will show all the 3 effects *g*, *f* and *c* together. This agrees absolutely with the results of Benedicks.

Besides the impurity *B* there may also exist another impurity *C* and indeed the last in a constant amount which the dotted section $a_1\ b_1\ c_1\ i_1$ indicates, so instead of the curves *ab* and *cd* we get the curve cut through the 3 dimension curve *abok* (liquid plane) *acli* (Solid plane) and *cdml* (Segregation plane), namely, the curve $a_1\ b_1$, $i_1\ c_1$ and $c_1\ d_2$. On account of the continual presence and about constant impurity of *C* one would observe that by a decrease in the amount of the impurity *B* not all the apparent transformation points disappear but the thermal effect i_1 is still present.

Finally a separate trial with a small percent of the 2 impurities *B* and *C* must give 3 thermal effects, namely, h_1 (more or less corresponding with the temperature a for pure zinc) g_1 and f_1 (the last 2 are strongly affected by the degree of purity) show that they are dependent on the degree of impurity. For a cored, unequalized, solid solution crystal, 3 more effects have to be added, namely two of the two binary eutectic planes and one of the ternary eutectic plane.

This short account clearly demonstrates how easily the presence of small and varied impurities not only can simulate a transformation point but in the hands of any investigator must give entirely other temperatures for the single effect according to the purity of his material.

The above has been abstracted by the authors from the more complete discussion of the questions involved in *Zeitschrift für Metallkunde*, Vol. 21, Oct. 1929, page 338.

Table 1.—Literature on the Allotropy of Zinc

Author	α	β	γ	Method	Reference
Le Chatelier	..	..	350°	Electric Resistance	*Comptes Rendus*, Vol. 111, 1890, pages 414 and 454.
Monkemeyer	170°	..	310°	Graph of Cooling Curve	*Zeitschrift für anorganische Chemie*, Vol. 43, 1905, page 182.
Benedicks	170°	270°	330°	Electric Resistance	*Metallurgie*, Vol. 7 1910, page 531.
Werner	..	..	304°	Thermoelectric Force	*Zeitschrift für anorganische Chemie*, Vol. 83, 1913, page 27.
Benedicks, Arpi	170°	270°	330°	Electric Resistance	*Zeitschrift für anorganische Chemie*, Vol. 88, 1914, page 237.
Lastschenko	..	..	340°	Heat Content	*Zeitschrift für Metallkunde*, Vol. 10, 1919, page 253.
Losana	170°	..	320°	Dilatometric-Measurement	*Gazzetta Chimica Italiana*, Vol. 53, 1923, page 539.
Pierce Anderson	..	..	..	Röntgengraph	*Journal Franklin Institute*, Vol. 200, 1925, page 349.
Freeman, Sillers, Brandt	..	..	..	Röntgengraph	*Scientific Paper* No. 522, *U. S. Bureau of Standards*, 1926.

Preparation and Some Physical Properties of Strontium-Cadmium Alloys

BY HAROLD C. HODGE* WITH OTHERS**

ALTHOUGH a number of alloys of the strontium-cadmium series have been prepared[1] there is no record of their properties except the appearance, and a few chemical reactions. Therefore taking the present interest in the industrial use of alkaline earth alloys as justification, it was purposed to prepare a large number of strontium-cadmium alloys, to determine as far as possible the thermal data, and to study some of the physical properties.

Alloys of calcium and cadmium up to 30% calcium have been prepared[2] and their properties studied. Magnesium-cadmium alloys[3] have been investigated to all concentrations. Since both calcium and magnesium form compounds with cadmium, we may expect according to Tammann's rule[5] to find compounds of strontium and cadmium.

Preparation of the alloys of strontium by direct fusion with another metal is not feasible due to the difficulty of obtaining and handling metallic strontium. The methods by which strontium alloys have been prepared may be grouped roughly as follows:

1. Caron's method of replacement from strontium halide.
2. Kroll's method of replacement from strontium carbide.
3. Acker's method of electrolysis.

The strontium-cadmium alloys were prepared, using an adaptation after Ray and Thompson[6] of the last named method, by the electrolysis of a fused, eutectic mixture of strontium and sodium chlorides over molten cadmium in a suitably wired crucible. The cadmium served as the cathode and a carbon rod as the anode. During electrolysis strontium was deposited in the cadmium and chlorine was evolved from the anode. Metallic sodium was frequently observed deposited on the crucible wall just above the cadmium alloy. Bits of sodium metal were often seen burning upon the surface of the salt bath after the electrolysis had run for an hour or more. It was found satisfactory to carry out the electrolysis at the lowest temperature at which the salt bath was completely molten due to the almost explosive tendency of cadmium to volatilize and oxidize at slightly elevated temperatures. During the electrolysis it was found necessary to refresh the salt bath periodically. Under high potentials there seemed to be a gaseous polarization which cut off the connection between the anode and the fused salt bath. Currents of 8 to 25 amperes at 4 to 20 volts were employed with best results from currents of 12 to 14 amperes at about 6 volts.

The alloys were reheated under a bath of pure strontium chloride from 2 to 3 hours and permitted to solidify in the crucibles.

Cooling curves were obtained using a thermocouple of constantan wires with a student potentiometer. The alloys were melted in an electric tube furnace using the precautions recommended by Ray.[7]

The specific gravity was determined on chill cast alloys both annealed and unannealed. A section of the casting was polished by sand paper, weighed in air and then in dry benzene of known density. The specific gravity of the alloys at 25° C. was calculated with reference to water at the same temperature.

The hardness of the alloys was determined using both the Rockwell and the Shore scleroscope hardness testers. In the Rockwell tests, a load of 50 kg. with a $^1/_{16}''$ ball was employed. The Brinell hardness tester crushed every specimen.

The surfaces of the alloys were polished, using a suspension of alumina in ether. The alloys were etched by air until suitable for microscopic examination. Further action of the air was prevented by a thin coat of dry oil.

The low current efficiency as well as the volatility of the salt bath and molten cadmium made it impracticable to obtain alloys of much greater than 25% strontium. Using a current density of approximately one ampere per square centimeter at the cathode the current efficiencies obtained are shown graphically in Fig. 1. "A" represents the variation of the current efficiencies with the

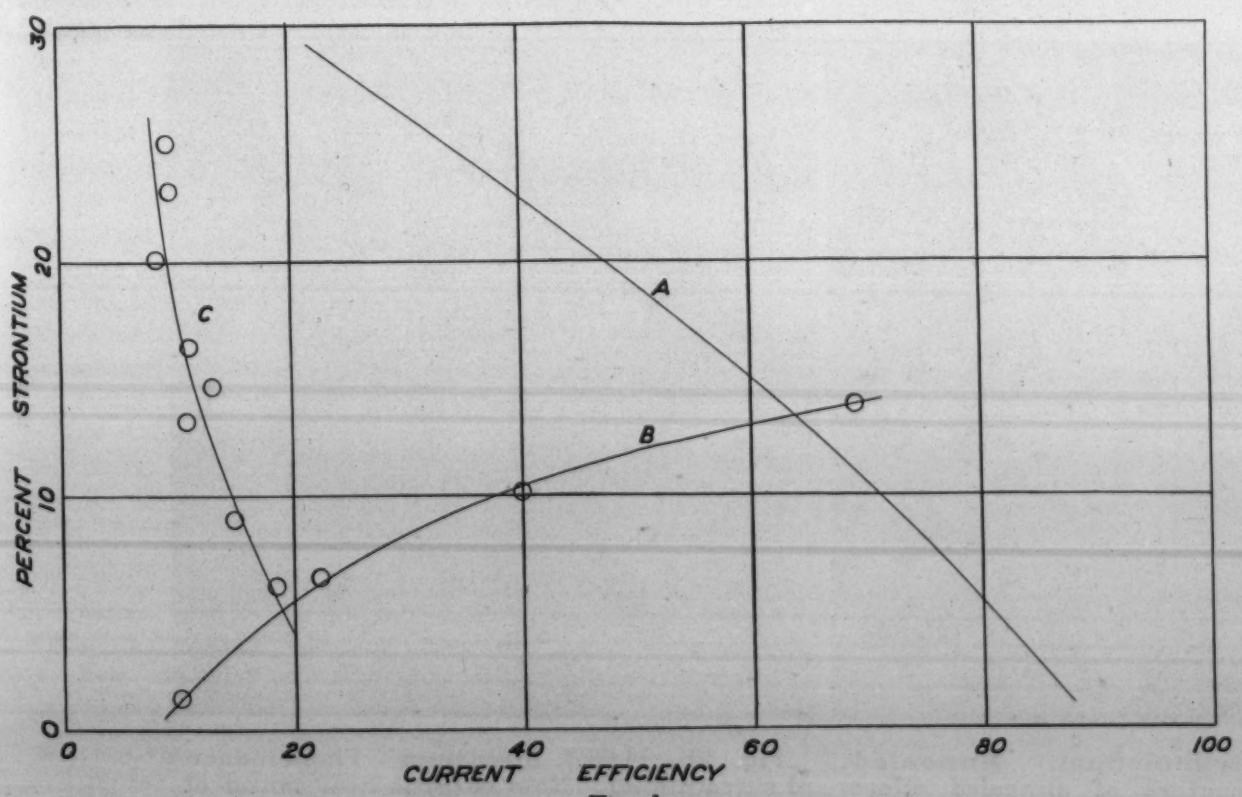


Fig. 1.

* Department of Chemistry, College of the Pacific, Stockton, California. Now at the University of Rochester, Rochester, N. Y.

** This problem was undertaken by a class in "Introduction to Chemical Research" composed of the following: Ronald Bloamer, Charles Crowell, Robin Dunn, Reiji Funabiki, Reginald Gianelli and Theresa Woo, directed by the author.

Fig. 2. 8.07% Strontium. Annealed. Contains small percent Copper. 100×.

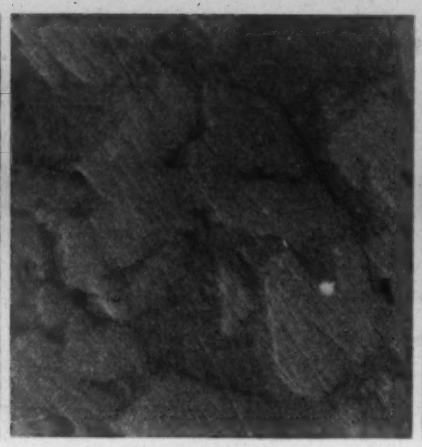


Fig. 3. 11.35% Strontium. Annealed. 400×.

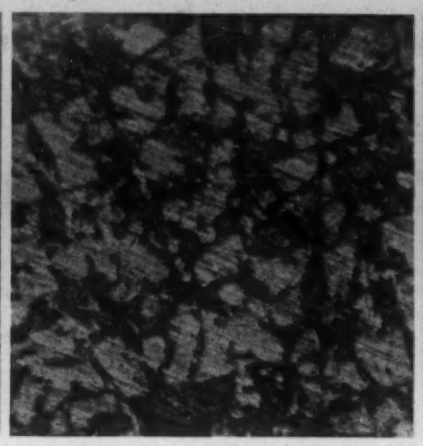


Fig. 4. 19.26% Strontium. Unannealed. 100×.

Fig. 5. 26.40% Strontium. Unannealed. Note 3 phases. 100×.

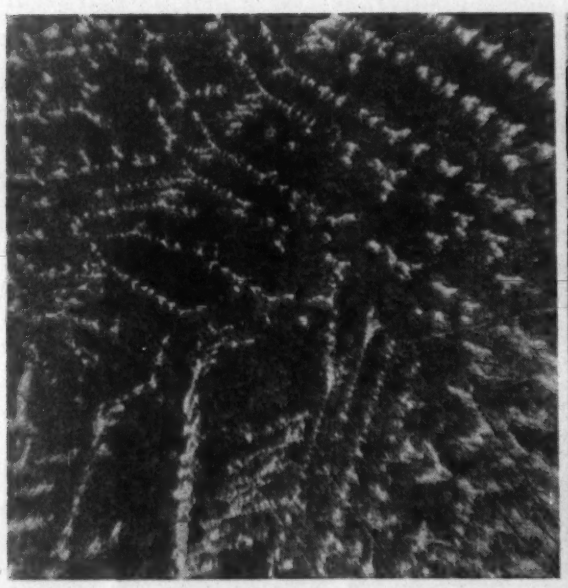


Fig. 6. 0.72% Strontium. Unannealed. White, Cd; dark, eutectic. 200×.

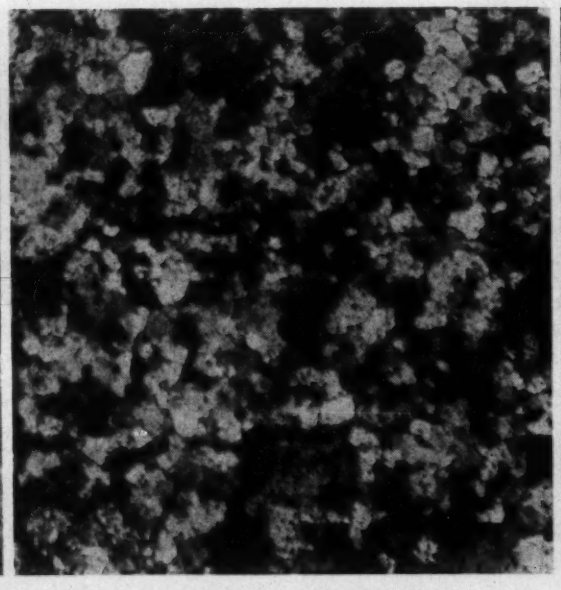


Fig. 7. 0.72% Strontium. Annealed. Typical microstructure of metallic cadmium. 200×.

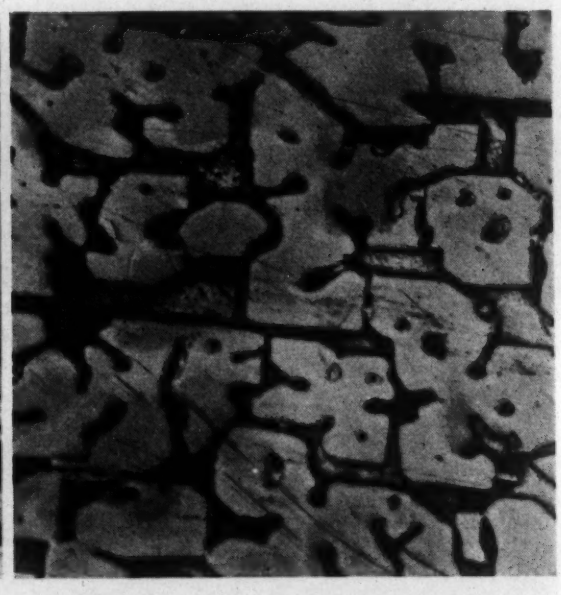


Fig. 8. 10.90% Strontium. Annealed. Contains small amount of copper. 400×.

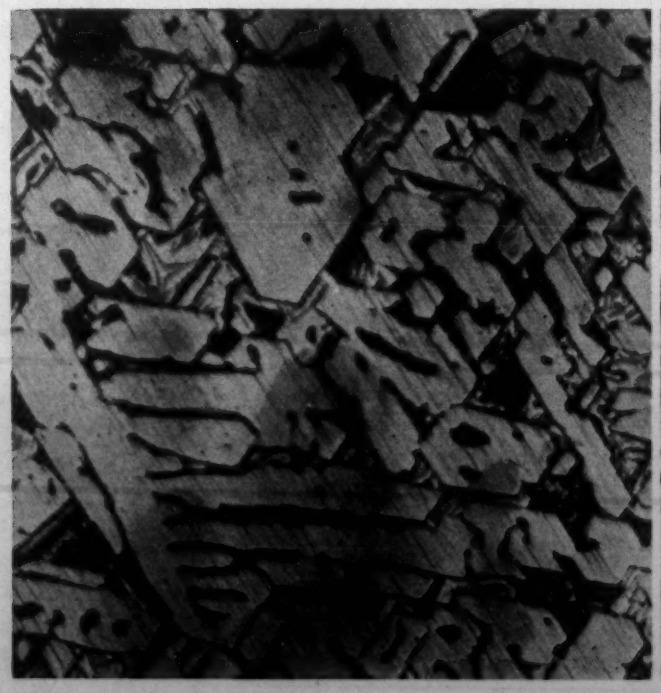


Fig. 9. 7.88% Strontium. Annealed. Typical microstructure of annealed alloys. 400×.

Fig. 10. 14.66% Strontium. Phenomenon of surrounding. Note eutectic near center of photomicrograph. 400×.

percent strontium in strontium-tin alloys found by Ray;[8] "B" shows a similar relation for strontium-cadmium alloys prepared in a chromium plated iron crucible; and "C" shows the variation for alloys of strontium-cadmium prepared in a clay crucible. Much higher efficiencies were observed using iron crucibles than using clay crucibles.

The analyses of the alloys were made using a modification of the Jellinek-Wolff[4] method. Samples of alloys containing up to 15% strontium showed negligible amounts of silicates present after reheating.

The data obtained by thermal analysis is given in Table 1. Due to the lack of precision of the apparatus used and the complexity of the phase relations in the solidified alloys, the thermal diagram cannot be satisfactorily presented. At least one intermetallic compound, probably $Cd_{12}Sr$, is present, and there seems to be indications of another, possibly CdSr. Two eutectics are noted, one at 0.9% and one at 13.8% Sr. The transitions in the solid phase are not clearly defined but may involve several forms of CdSr. In all slowly cooled specimens, with less than 6% strontium a large percentage of metallic cadmium is present.

Table 1.—Thermal Analysis Data

Strontium in Alloy %	Beginning of Solidification ° C.	Second Arrest ° C.	Third Arrest ° C.	Final Arrest ° C.
0.72	316	316		
2.59	348	316		
5.93	375	370	290	270
7.40	366	340	290	270
7.88	362	332	286	270
11.35	316		290	270
14.86	320		297	265
19.26	348	316	295	265
26.30	366	316	290	265

Micrographs of several of the alloys are shown in Figs. 2 to 10. The "chinese script" shape of the crystals is characteristic of the alloys. An inadvertent addition of a small amount of copper to 2 alloys (Figs. 2 and 8) gave an interesting segregation of the cadmium in even sized crystals of irregular outline. By annealing alloys of very low percent strontium the typical microstructure of cadmium metal appears (Fig. 7). The phenomenon of "surrounding" is well illustrated by the photograph of the alloy containing 14.86% strontium (Fig. 10) in which an arrested transformation of a higher compound is indicated. Annealing the alloys containing more than 8% Sr gave massive cadmium crystals.

These alloys exhibit the unusual combination of softness together with brittleness. The hardness of the alloys increases with increasing amounts of strontium in an irregular fashion as shown by Figs. 11 and 12. The doubly circled points in the Shore scleroscope hardness-composition curves represent the values for annealed alloys whose composition is shown after annealing. The reason for the anomalous softness of the alloy highest in strontium is not known.

The specific gravity of the alloys is shown in Fig. 13. The calculated values using the additive law are plotted on curve A, the values found for the annealed samples are interpolated by C, and for the unannealed alloys by B. An expansion after annealing was observed in many alloys of low percentage strontium while contraction accompanied annealing on all alloys of higher strontium.

The authors wish to acknowledge their indebtedness to Dr. K. W. Ray of the State University of Iowa for suggestions and for assistance in the photomicrography, and to Professor J. H. Jonte of the College of the Pacific, for his aid and encouragement.

[1] Gautier. *Comptes Rendus*, Vol. 133, 1901, page 1005; Vol. 134, 1902, page 1054.
[2] Donski. *Zeitschrift für anorganische Chemie*, Vol. 57, 1908, page 185.
[3] Bear. *Zeitschrift für anorganische Chemie*, Vol. 70, 1911, page 352.
[4] Jellinek & Wolff. *Zeitschrift für anorganische Chemie*, Vol. 146, 1925, page 329.
[5] Tammann. Textbook of Metallography. Chemical Catalog Company, 1925, page 228.
[6] Ray & Thompson. *Metals & Alloys*, Vol. 1, 1929, page 314.
[7] Ray. *Metals & Alloys*, Vol. 1, 1929, page 112.
[8] Ray. *Industrial & Engineering Chemistry*, Vol. 22, 1930, page 519.

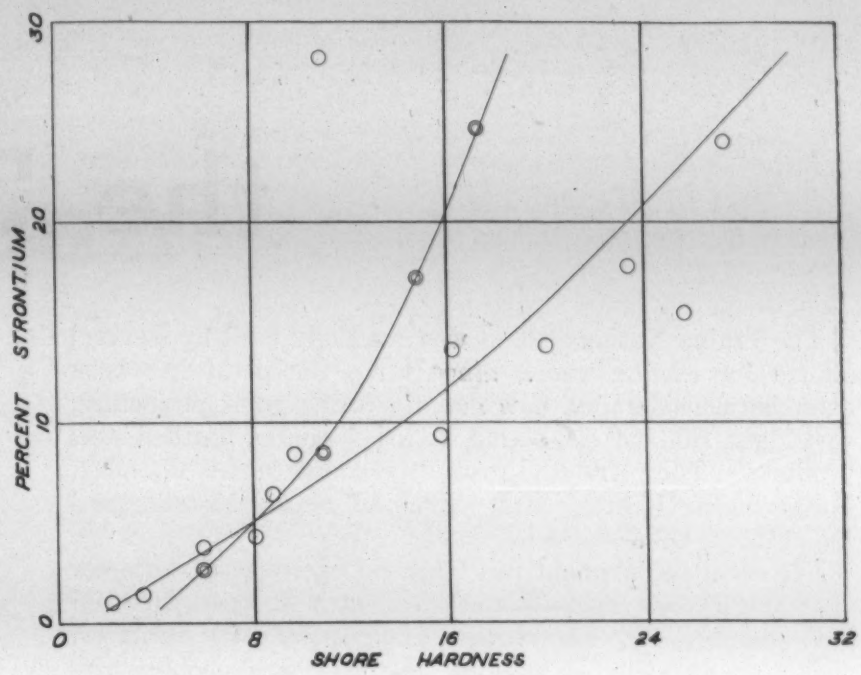


Fig. 11.

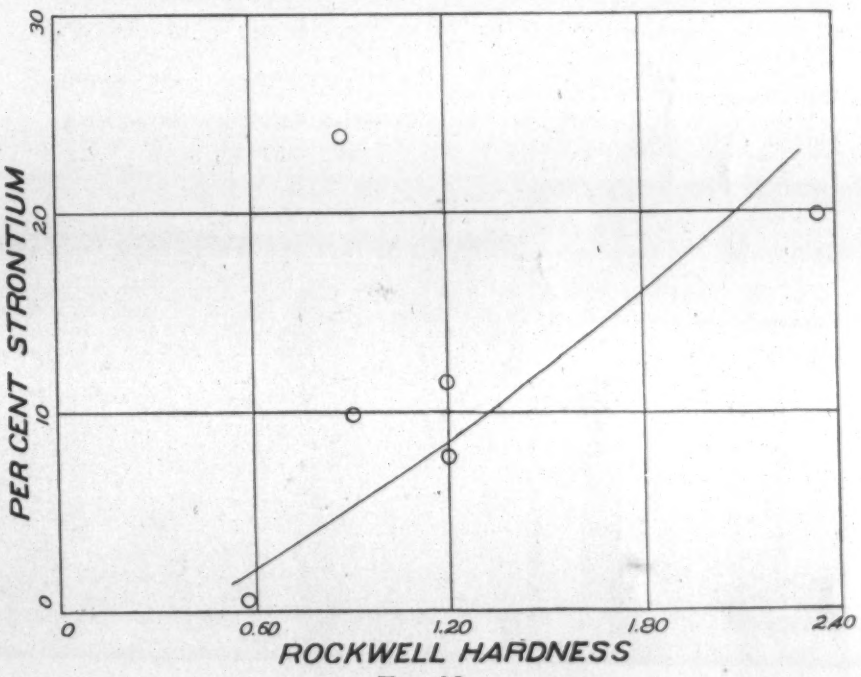


Fig. 12.

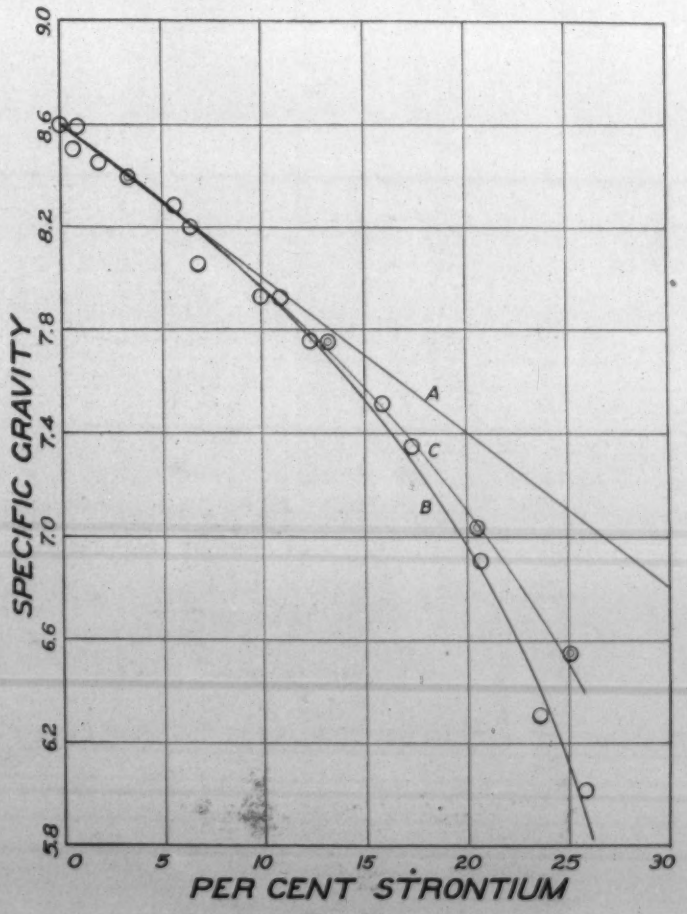


Fig. 13.

The Plant and the Trubia Fàbrica

BY A. G.

The Trubia National Plant was originally built by General Elorza for casting guns. Since then, the plant has been extended considerably, now manufacturing guns, projectiles, cartridges, rifle barrels, blanks, rolled, forged or finished steel products. The plant comprises Steel Department, Foundry, Forge Shop, Rolling Mill, Machine Shop, Metallurgical Laboratory, Offices and Library.

The Steel Department has two acid open-hearth furnaces of 40 and 25 tons capacity, and two electric furnaces, an 8-ton Fiat and a $^1/_2$-ton 'Lectromelt. The open-hearth furnaces, placed on an elevated working platform, are mechanically charged by an electric charging machine and the gas is supplied by a battery of three Chapman type gas-producers each capable of gasifying 880 lbs. of coal per hour. The charges are made up of Swedish and Spanish pig iron and plant scrap and additions of ferro-alloys are made in the furnace. The Fiat furnace is provided with electrode economizers and the electric equipment allows changing voltage to produce either acid or basic steel according to the available scrap. The small 'Lectromelt furnace is used for research and experimental work. The movement of ladles, ingots, etc., is accomplished by four overhead cranes, two of 25 tons, one of 50 and another of 75 tons.

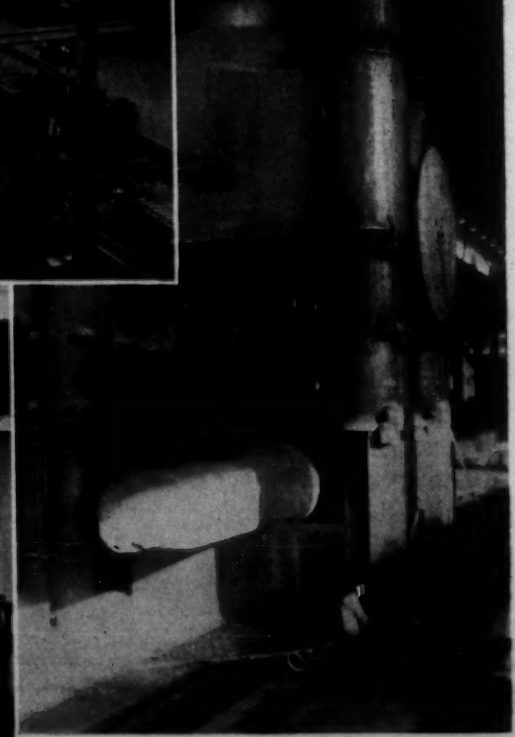
In the same building are installed a 3000-ton Whitworth hydraulic press and a Davis of 1000-ton capacity for forging gun tubes, shafts, and other large forgings. Several other vertical and horizontal presses are installed in other buildings for piercing and drawing of projectiles.

* Published with the permission of the Artillery Section of the Spanish War Department.

** Metallurgist, Fábrica Nacional. (Formerly Research Fellow, U. S. Bureau of Standards.)

Quenching a gun tube.

The Artillery Machine Shop.



Forging an ingot under the 3000-ton Hydraulic Press.

The Fiat Electric Furnace.

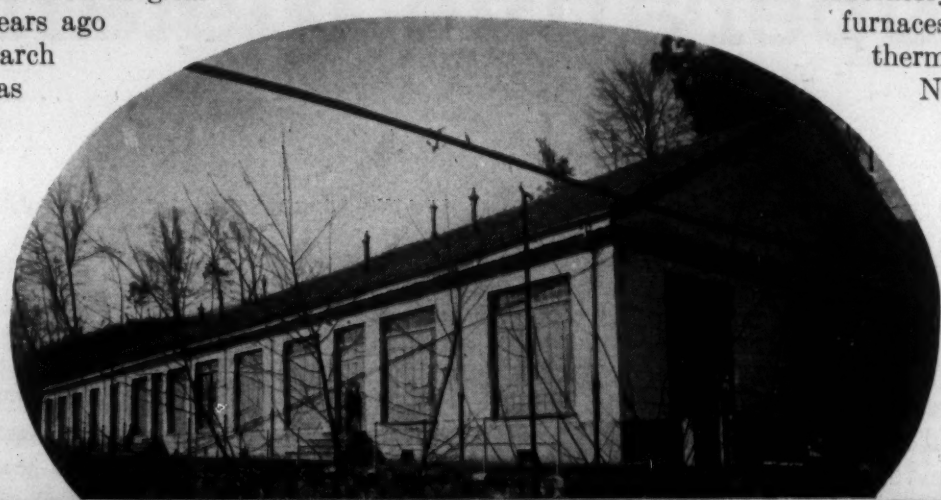
Laboratories of Nacional in Spain*

SOTO**

The Foundry is equipped with two cupolas (43 in. diameter × 20 ft. high and 27 in. diameter × 18 ft. high) two oil furnaces of 1000 kg. and 300 kg. capacity, a crucible furnace and two mold and core drying ovens. For molding there are several molding machines and a sand mixing machine.

The heat treatment of gun tubes is carried out in two circular gas fired furnaces $32^1/_2$ and $45^1/_2$ feet in height, with a quenching bath between them and an overhead crane for suspending the tubes. Four continuous furnaces are used to heat treat projectiles and at present two electric furnaces for quenching and drawing rifle barrel blanks are being installed.

To meet the rigid specifications laid down for the products of this plant, all the steps from the raw materials to the finished products must be carefully controlled. This control is carried out by the Metallurgical Laboratory, which three years ago was enlarged to include research work. The laboratory has three sections. The Chemical section has four laboratories for general analysis, a balance room and several specially equipped laboratories to analyze coal, coke and oil. The Metallographic section is equipped with two polishing machines, a Reichert microscope, an optical bench to photograph macrostructures, a Brown critical point machine and a Chevenard dilatometer. The Physical Testing section has two universal tensile, compression and transverse testing machines of 20- and 100-ton capacity, bend and wear testing machines, a repeated bending and a repeated impact bending machine for fatigue testing, a Charpy pendulum of 30 kgm., a machine for shear and transverse testing of cast iron, hardness testers (Brinell, Rockwell, Scleroscope, Herbert pendulum and Microcharacter) and two Hoskins electric furnaces for heat treatment. For cutting tests of tool steel a Mohr & Federhaff lathe provided with devices to measure the forces acting on the tool in cutting, permits a close determination of the breakdown point. A Pyrometric Control laboratory equipped with electric furnaces, rare and base metal thermocouples and a Leeds & Northrup potentiometer completes the Metallurgical Laboratory.



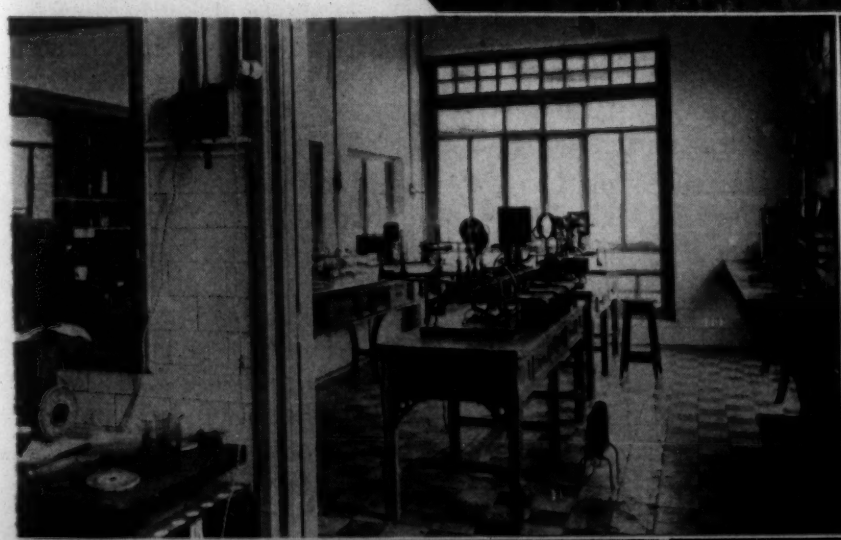
Top View—The Metallurgical Laboratory Building.

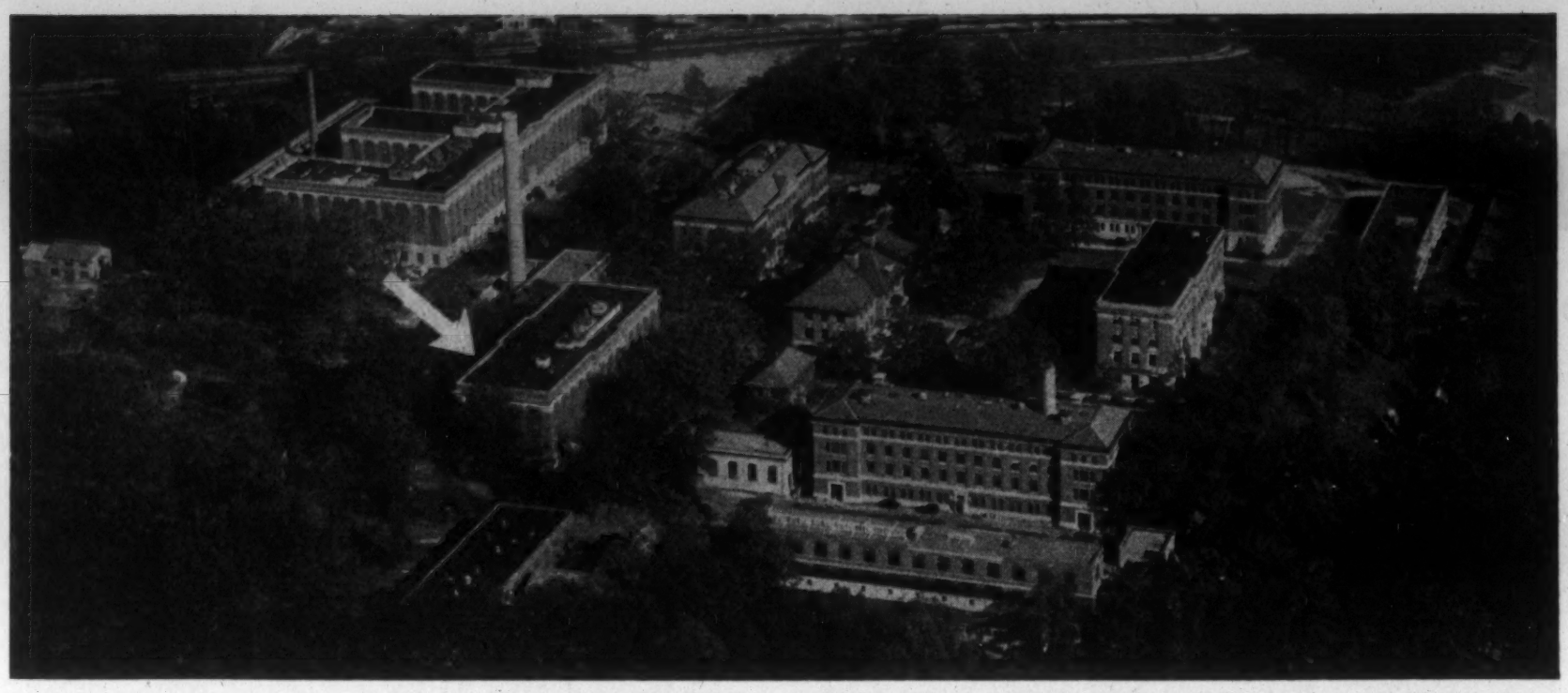
Upper Left—The Metallographic Laboratory.

Lower Left—One of the Chemical Laboratories.

Upper Right—A portion of the Physical Laboratory where practically every known test can be conducted.

Lower Right—Lathe for Cutting Tests of Tool Steels.





National Bureau of Standards; Division of Metallurgy building indicated by arrow.

Coöperative Metallurgical

SOMEONE has to carry out the research work that underlies all modern technical advances. In earlier days an individual or a firm with a problem worked it out as best he, or it, could, patenting it, or holding it as a trade secret. Others, seeing the applicability of the invention, discovery or process to their own problems, modified or added to the initial findings by further investigation, and in time the new knowledge spread and was used, but it spread slowly.

To-day we must cut down the period of incubation, and apply new facts more rapidly. Since new facts are valuable to all who can use them, it is logical for all who need new facts to join in the search for them so as to have immediate knowledge of them and the right to use them. Hence joint research attack of problems of general interest is becoming more and more popular, and this is as true in metallurgy as in any other line. But what is a joint problem, and how may it best be jointly studied? And when a project is recognized as a joint one, and the proper way to attack it is clear, how may it be financed?

At one end of the scale stand problems such as those of the small farmer. Knowledge of fertilizers, crop rotation, the best diet for pigs, and so on, redounds to the advantage of millions of operators of small farms, none of whom can finance extensive research. When the multiplication factor is so great, financing and carrying out of research by the Federal and State Governments is the only feasible method. The information must be found, and once found, its application must be more or less forced upon those who should use it. Hence such organizations as the Farm Bureau.

At the other end stands a commercial group with a practical monopoly, the Aluminum Company of America, the International Nickel Company or the Vanadium Corporation of America, for example, which profits directly and obviously from its research discoveries, and can normally look to no one but its own organization to initiate and carry on research projects aimed at new uses for the material with which it deals. User experiences, ideas, and suggestions play a large part even in these cases, but the user will carry on an investigation only so far as it bears on his own problems, and the producer must round it out to make the most of its potentialities.

Even such firms as these with strong and able research departments, find many cases where the factor of credence demands joint instead of individual action. If a producer shows evidence that his product is best fitted for a given use, the user is prone to class it as advertising, and not to believe it until he himself, or another user, has independently amassed such evidence as a check. He is suspicious of data favorable to the producer coming from the producer alone, because he knows that there is an axe to grind. He expects the producer to put his best foot forward, and so he takes the producer's statement with a grain of salt. "Ask the man who owns one," and "We are advertised by our loving friends," are slogans reflecting the psychology of the consumer attitude.

There are several ways to secure consumer credence. One, ably used by the firms named above, is to do the research work so well and so thoroughly that there are no loop-holes left, and the report of the work is credible. The good effect of such treatment is enhanced when the report is given before a scientific or technical society rather than solely in company advertising, that is in a place where it must stand the barrage of open discussion, as well as pass the Papers Committee. But even then, there may be some delay in the acceptance of the facts until they are corroborated by some disinterested party.

Exactly the same data and conclusions therefrom published by a detached and obviously impartial research agency such as a government or university laboratory, or an institutional laboratory whose reputation for scientific precision and impartiality is its most precious possession, will be promptly accepted without question.

Similarly, if the project is handled jointly through a technical society where producer and consumer, as well as impartial "general interests," are represented on the committee, and the set-up is such that everyone knows that nothing can be "put across," immediate credence is gained. When specifications and research leading to specifications are concerned, this is the only satisfactory way, as its use by the American Society

Research Laboratories, Westinghouse Electric & Manufacturing Company.

Research—How?

By H. W. GILLETT

for Testing Materials shows. After a project has filtered through the committee in charge, and finally through discussion in open meeting of the full society, the findings thereon are taken as representing the real facts as found by work which has hewn to the line, letting the chips fall where they may.

But large bodies move slowly and, of necessity, with due deliberation, so that this is a rather unwieldly method, applicable to a research project only when the active direction is in the hands of a small, alert, steering committee. It finally accomplishes the maximum in credence, but seldom attains its objective very speedily.

A good example of work so handled, and far more speedily than is often the case, is the research work of the Die Castings Committee of the A.S.T.M. By splitting up the work among the laboratories of zinc producers, of makers and of users of zinc base die castings, the laboratories being sufficiently interested in getting at the facts to justify spending real money on the problem, very real advances in the quality and permanence of such castings are being made.

Another useful Committee is that of the A.S.T.M. on Fatigue Research. While it has no experimental program of its very own, it consists of men active in the field who use the Committee as a clearing house for information to the advantage of the projects with which each is concerned, and to the advancement of knowledge in that field. Its Committee reports on the "state of the art," and its collected abstracts are most useful.

A more recent A.S.T.M. project in the field of metallurgical research is that on embrittlement of galvanized structural steel. This is steered by able representatives of the steel producers, the galvanizers and fabricators, and the users of the finished product.

Major problems often transcend the scope of a single society, and fall into the hands of joint committees, generally with one of the sponsor societies exerting the major effort.

The Joint Molding Sand Committee of the American Foundrymen's Association and other societies, has done a great work in developing simple methods for control of foundry sands and in spreading their use to hundreds of small foundries which individually could not have gone very far in research. No one will ever be able to calculate the national savings due to reduction of foundry scrap that results from the work of this group.

The Joint Committee on the Effect of Temperature on the Properties of Metals, of the American Society for Testing Materials and the American Society of Mechanical Engineers is an outstanding example of useful joint action.

The Alloys of Iron Research, sponsored by Engineering Foundation, the American Iron & Steel Institute and many other societies, is actively at work trying to correlate and codify the vast amount of undigested information in the field of alloy steels, and is digging the producer and the user of alloy steels out from under the "avalanche of unrelated facts." This is organized and financed on a scale fairly comparable to the magnitude of the task.

An example of joint metallurgical investigation backed by the Government, by an educational institution and by industry, is that which was carried on at Pittsburgh by the Bureau of Mines, Carnegie Institute of Technology and the Metallurgical Advisory Board, on the Physical Chemistry of Steel Making.

That this project is no longer to be backed by the Bureau of Mines illustrates a difficulty that has to be faced in long-time coöperative jobs—the possibility of an executive of the coöperative type being succeeded by one of a more individualistic type. In this particular case, it seems odd that the Bureau of Mines should risk the loss of prestige that will result if things go on so that it becomes clearly stamped as no longer having the coöperative spirit that actuated it from the days of Holmes through those of Bain. It is hard to see what alternative project it can take up that would be of such moment as to represent as good an investment of the tax-payers' money as would a continuation of the coöperative work for and with the steel industry.

The tendency in other progressive countries is toward greater sympathy with and coöperation in metallurgical research on the part of the Government, and, if this action by the Bureau of Mines is to be taken as an index of its future

Department of Engineering Research, University of Michigan.

attitude, that Bureau is headed for a period of vastly reduced usefulness and standing. Fortunately, the Bureau of Standards still remains anxious for and responsive to the advice of industry, and always shows a fine coöperative spirit.

There are always several points of view among the coöperators in any project and usually the leaders have strong personalities. Change of leaders brings in other personalities and upsets the original conditions under which coöperation would have continued smoothly. To insure freedom from pitfalls under changed conditions, a continuity of organization is called for. Many details as to distribution of credit, ownership of results and so on, that are originally dismissed as sufficiently covered by a gentlemen's agreement, and which would hardly introduce complications if everything remained as it was at the start, ought to be very clearly expressed in a hard and fast agreement.

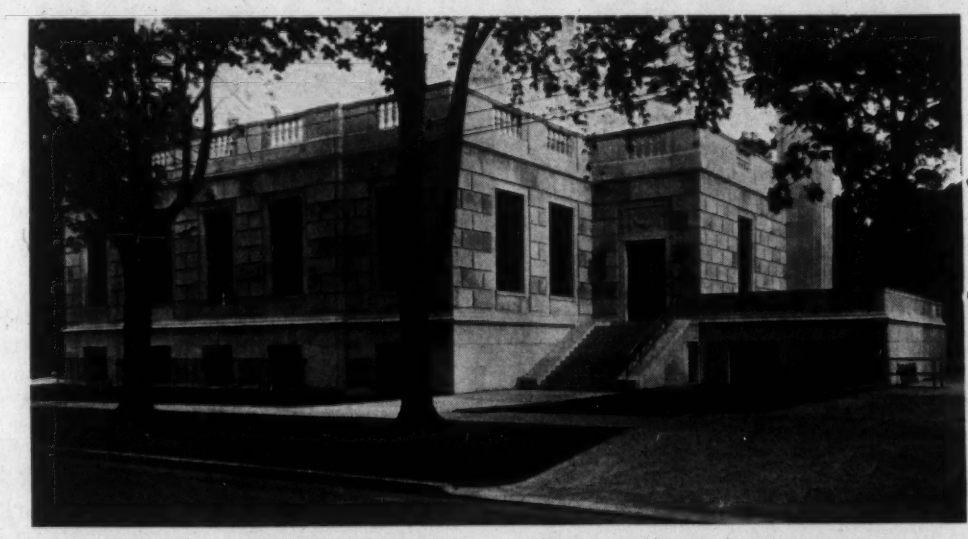
Lessons for future coöperative projects can be learned from those of the past and present, not only in regard to the features that proved successful, but also as to those in which difficulties were met.

Trade associations are more and more coming to the point of joint laboratory attack on problems peculiar to the industries which they serve.

The Copper and Brass Research Association, the Zinc Institute, the Malleable Iron Research Institute, the Gray Iron Institute, the Pressed Metal Institute, the Lead Institute, the Non-Ferrous Ingot Metal Institute, the Non-Ferrous Bearing Metals Research Group, and others of that ilk, are all to a greater or less degree concerned with joint technical metallurgical problems. Trade associations can often deal with a project more speedily than can a technical society, because they can practically tax their members for financial support of an investigation whose successful outcome means money in their pockets, while the society can only request contributions. But even though producers and users of a given commodity join in the work of a trade association, complications arise in allocating the work to different plant laboratories because the members, while banded together for common purposes, are more direct competitors than are the average run of society members. Moreover, the credence factor comes in because the trade association must not only secure acceptance of its findings within its own group, but must convince the general public that those findings are not colored by its desire to spread the use of its own commodity at the expense of other commodities. Hence, in general, the trade associations will do better to farm out their problems to institutional laboratories than to handle them solely in the laboratories of their members.

Besides these society and association groups of national scope banded together by community of interest, there are more compact groups, of which there are again two wide extremes. Firms such as the U. S. Steel Corporation, General Motors, General Electric and the du Pont group, for example with wide-flung interests and scattered plants, find in their own activities, necessity for joint action along research lines, and establish their own central research laboratories to serve all the plants, while maintaining control laboratories and specialized research laboratories at the various plants.

Sharply contrasted with such groups with unified financial interests are groups of competitors who band together for solution of their technical problems. The Electric Steel Founders' Research Group and the Steel Castings Development Bureau come into this category. In such cases, the existence of the central laboratory or the coalition does not do away with the need for added joint action with still other interests through technical society or trade association activities. Each line-up fits some class of problems.



Metallurgical Laboratory, Ontario Research Foundation.

These examples will show that there is an existing mechanism for joint attack on most any joint problem in the metallurgical field, or at least an existing example of some coalition whose organization and methods might be copied. Such mechanism has been brought into existence by the exigencies of the situation in most progressive countries. In Soviet Russia and to a lesser degree in Italy, joint action through Government means is pretty much forced on industry. We do not want to copy that here. In England, there is Government subvention to groups banded together for research purposes, such as the British Cast Iron Research Association and the British Non-Ferrous Metals Research Association. Joint support of the Ontario Research Foundation by industry and by the Government obtains in Canada. Germany is just full of Institutes for metallurgical research usually located at one of the Technical High Schools, and jointly supported by trade associations or local industrial groups, by technical societies and by the Government. In these countries, while there are many large firms with their own research facilities, the average firm is smaller than in the

United States, and the tendency toward joint research among a considerable number of small firms is very marked.

Joint metallurgical research is everywhere the order of the day. Nevertheless, there are plenty of problems that should still be handled individually without letting the other fellow in on them.

The differentiation between a problem suitable for joint study and one on which individual attack will be the better, usually hinges on how widely its results will be applicable, and on how much of a figure credence cuts.

If the investigation is one to show how to cheapen the production of a material already in commercial use, or how to get more uniformity of quality in its production, it is usually a matter for distinctly individual attack. If it deals with the development of a new specialty within a given industry, that ordinarily falls also into the individual class.

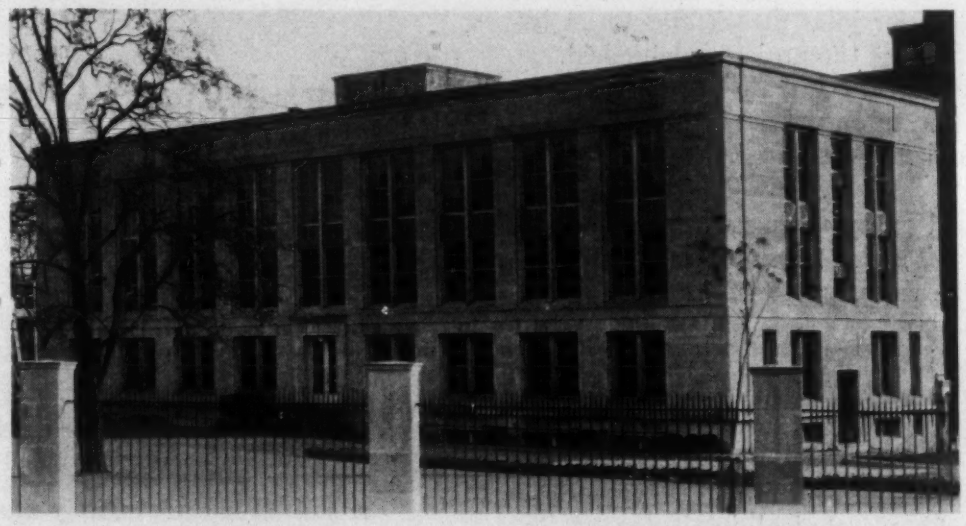
But if the problem deals with extension of uses for a given metal or for material made by some given type of metallurgical process, (unless the production is a very definite monopoly), the information will help all producers, it cannot be kept secret for it has no beneficial effect unless it is broadcast, and many producers can offer useful suggestions in outlining the project and in applying its results. Nor is it just that all should profit from the effort of one without helping to finance the work. Such a problem can well be handled jointly, though if a joint consciousness of the need for the information does not yet exist, it may be such a slow process to work up interest and support that a firm which all by itself takes the bull by the horns, and develops and uses new information regardless of whether its competitors as well may profit thereby at a somewhat later date, may often cash in on its enterprise.

When the project in any direct way relates to specifications so that not one producer only, but many and many users as well, are concerned, then joint action is the only effective method, for the necessity for credence outweighs the necessity for speed.

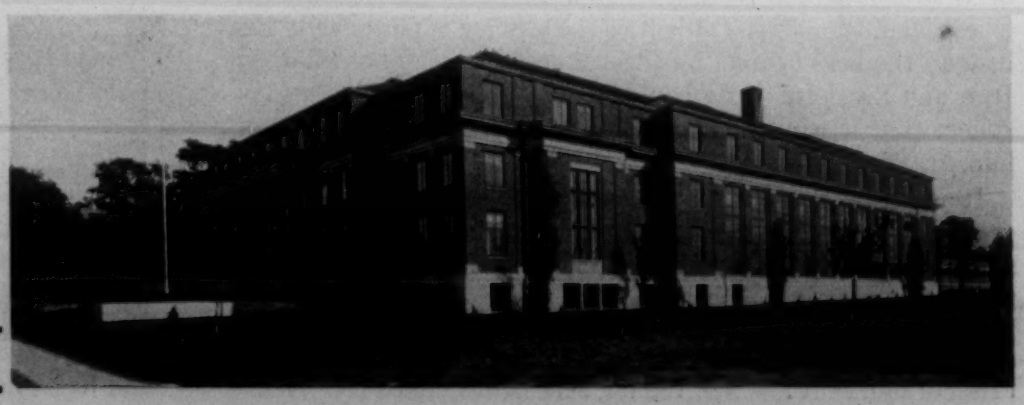
When the new information sought relates to "fundamentals," is probably not patentable, and certainly cannot long be kept secret, and where the work required is so extensive as to be beyond the capabilities of most research organizations by themselves, then joint action registers its most direct hits. Similarly, when, as in the Alloys of Iron Research, the work obviates duplication and overlapping of effort on a smaller scale by many organizations, joint action is far more effective and cheaper in the long run than is scattered individual attack.

One psychological difficulty is met in financing joint research. Those who will profit by it are prone to feel that since other firms are equally benefited, a few hundred dollars from each is enough for any joint project, however extensive. Moreover, the project must first be "sold" to the Director of Research who may hesitate lest the allotment means skimping on some of the projects already in his laboratory, or who may fear that his advocacy of the project before his Board of Directors will be interpreted as an admission that he is not competent himself to carry out all the research in which the company should engage. After he is sold, and the question goes to the Directors, they may deliberate at greater length on an appropriation of $500 for joint research than they would over one of $50,000 for direct company research. It may be much easier to get a promise of thousands of dollars worth of work on the project in the company's laboratories than a subscription of a few hundred for work to be farmed out, although the factor of crediability may demand that it be farmed out. And too often, the Finance Committee puts the matter up as a scientific charity rather than a business proposition, though most joint projects are distinctly the latter. The way of the Finance Committee of any joint project is not particularly easy, and it may find that it has collected too much to justify giving up the project, and too little to finance it adequately.

Then there is a peculiar psychology which besets the average Steering Committee when it comes to allocating the work. While no individual on the Committee would think of entrusting a project of the importance any joint project must have to justify the joint action, to the hands of a "cub," were



Research Laboratory The Gulf Companies.



Battelle Memorial Institute.

the work to be done in his own laboratory solely for his own firm, yet he is prone, as a Committee member, to think first of handling the problem by means of a fellowship at some university where it will be directed by a professor who has little time for it from his teaching duties, and where the actual work will be done by youngsters with their eyes chiefly fixed on getting their degrees, and only looking cross-eyed at the part-time research work which pays them but a pittance. The Committee may not even contemplate remunerating the professor, figuring that he should help out "for the good of the cause." Some projects can be handled this way, but the majority demand full-time, experienced and adequately-paid effort.

A joint project that does flivver, sets the group which has started it back pretty badly, since the next time it approaches a firm for support of another joint problem, it will be asked, "What did you do with that five cents I gave you last week?"

Other drawbacks are the danger that a committee member whose firm has put a few hundred dollars into the pot, may thereby feel authorized to assume the direction of the whole shooting match, and the possibility that some contributors who do not understand that research on projects of this scope is slow anyway, and especially slow when steered by the average committee, may become disgruntled when the problem does not yield up a solution over night.

Notwithstanding all the difficulties, technical, financial and psychological, there is enough history of effective joint research action to allow appraisal of a project as to whether or not it classifies as suitable for joint attack and to let its pilots steer clear of the rocks once the project is launched.

The most important thing, after adequate financing, is not to have too many pilots, but to entrust the ship to an experienced, broad-minded and not too large, Steering Committee.

Speller*, evidently spurred on by the need for carrying on the work on Physical Chemistry of Steel Making since the defection of the Bureau of Mines, put forth an interesting proposal.

He suggested the formation, under the auspices of an association of American iron and steel manufacturers, of a Central Metallurgical Research Board which should pass upon suggested research problems of a non-competitive nature, finance them and farm them out to suitable laboratories, perhaps ultimately establishing technical institutes of its own.

Such a Board must guard against arrogating to itself the position of supreme arbiter and coördinator in such a way as to alineate rather than attract other groups. If this is avoided, so that a project which the Board does not decide to take up is not thereby given too permanent a black eye, the scheme seems well worthwhile. In a word, those firms which believe in coöperative metallurgical research, would finance it, leaving the selection of problems and the allocation of funds to a Board that would be competent to appraise the economic and technical value of the projects suggested. If such a scheme should be adopted, it would require only the initial sales work to convince the executives that the scheme was worthwhile, instead of a new sales campaign for each individual project. In this respect, the scheme offers an overhead saving similar to that accomplished by the Community Chest idea, though the object of the scheme is not charity but instead the best type of business investment. The American Iron and Steel Institute could readily create such an atmosphere that it would be considered the proper thing to do to join in.

It is to be hoped that the suggestion will fall on fertile ground even though the industrial conditions at the time the seed was sown may not provide enough "showers of blessing" to make it germinate very rapidly. The seed may well prove to return a hundred-fold, so those who are interested in the development of metallurgical research in this country will watch with interest the reception and ultimate disposition of the suggestion by the American Iron and Steel Institute.

A considerable time will necessarily elapse before this "Community Chest" idea or some other that might accomplish the ends in view, can be worked up, accepted by industry, and put into effect. The proposal, while it should ultimately afford a better way than the present, is one for the future. We still have to deal with the present, and each project must individually secure its own support. The continuity of the highly important joint projects now in hand should not be interrupted. It seems specially worthwhile for industry to provide adequately for the work on Physical Chemistry of Steel Making which has been handicapped as to funds by the withdrawal of the Bureau of Mines, and for such projects as those of the Joint High Temperature Committee on Effect of Temperature on the Properties of Metals. There is no trade association in existence with power to tax its members that can handle the financing of such projects, and the supporting group has to be built up around the particular problem, as has occurred in regard to the two projects named.

Where such groups have been built up and are going concerns with much fine work to their credit, it is certainly a good investment to keep them going.

* F. N. Speller. Coöperative Research in the Iron and Steel Industry. Preprint for May 1931 meeting, American Iron and Steel Institute, 23 pages. Extended abstract in *Iron Age*, Vol. 127, June 18, 1931, pages 1967–1971.

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Molybdenum Cushions Protect Tantalum Carbide Tools

A new method of applying carbide tips to cutting tools has recently been perfected by Ramet Corporation of America, North Chicago, Illinois, and is now being used in many of the tantalum carbide tools manufactured by this company and its licensees.

An insert of pure molybdenum metal is brazed between the steel shank and the tantalum carbide tip. Molybdenum having almost the same coefficient of expansion as the tantalum carbide alloy known as Ramet, the use of molybdenum inserts effectively prevents strains being set up or cracks developing in the cutting tips as tools cool after the brazing operation.

Such strains as may develop between the molybdenum insert and the steel shank are entirely absorbed by the molybdenum, due to its great ductility.

Molybdenum inserts are especially desirable in tools where the carbide tips are long, thin or of unusual shape; or where unusually severe conditions of operation are expected.

In small tools the tantalum carbide tip is now often mounted on a shank of solid molybdenum.

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Savings of approximately $16,000 a year are realized from salvaging metals from ashes produced in the scrap incinerator at the Schenectady plant of the General Electric Company.

The ashes, instead of being loaded into a dump car and delivered to the dump, are first run through a ball mill, where they are pulverized, the larger pieces of metal passing out of the mill and over a magnetic separator, which separates the magnetic scrap from the non-magnetic material, which consists of copper, brass, aluminum, etc.

The finer material which is discharged from the ball mill passes over an inclined, longitudinally grooved "concentrating table," which has a stream of water flowing crosswise of the material.

The metal being heavier than the ash, slides down the bottoms of the grooves and falls off the lower end of the table, while the ash is washed off the side of the table and is then pumped through a "dewatering cone" which discharges the dewatered ash in a dump car. The ash is used for filling in low ground and the metals and concentrates are sent to the smelter or sold as scrap.

By this method approximately 100,000 pounds of ashes are ground and washed and from 20,000 to 25,000 pounds of metals and high grade smelting material is recovered each month.

The Status of Chromium Plating* by W. Blum**

AN EXTENDED ABSTRACT BY H. W. GILLETT

The properties of chromium make it suitable for various applications, unfitted for others. Its hardness gives it wear-resistant properties, but its brittleness must be considered in wear-resistant use. To some degree, these properties are under control by varying the temperature of deposition. Since the thermal expansivity is low, the coating may become detached on heating. Heating expels the hydrogen co-deposited with the chromium and causes shrinkage and softening. More knowledge of the factors governing the hydrogen content is needed.

The metal has high reflectivity in the ultra violet. Its value for ordinary use as a reflector depends on its resistance to tarnish, due to its surface film of oxide. Its electrical conductivity is high, but it makes a poor electrical contact because of the oxide film upon it. Its resistance to wetting extends not only to aqueous solutions but to molten metals also, so it is difficult to solder.

Since plated chromium coatings are porous and often contain fine cracks, they are not sufficiently impervious to protect underlying steel from corrosion. They are oxide coated in the passive state, and do not give anodic protection. Hence, coatings of softer metals such as copper and nickel that can be buffed to close up pores are essential as basis for the top coating of chromium applied for looks, tarnish resistance and resistance to wear. A top coat 0.00002″ thick is generally used in automobile practice, over 0.001″ of copper plus nickel.

The porosity of a chromium coating can be measured by depositing copper upon it. The copper deposits only at pinholes and cracks (See Fig. 1). Using this as a means of evaluating the continuity of the coating, it is shown that deposition at high temperatures and high current densities avoids porosity and cracking.

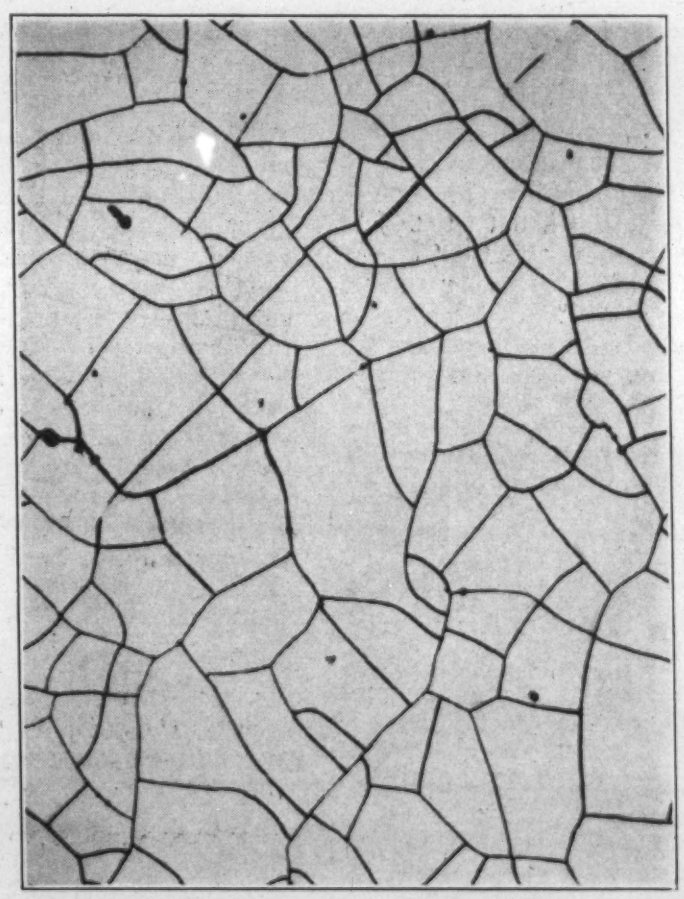


Fig. 1. Cracks (lines) and pinholes (spots) in 0.00011-in. chromium coating on nickel brought out by copper plating. 100×.

The plating conditions as to temperature and current density for a bright deposit depend not only on the bath but also on the nature and condition of the cathode. The notoriously poor "throwing power" is combated by auxiliary anodes or other mechanical arrangements of anode and cathode so as to produce more uniform distribution of current.

The solution is 250 to 400 g./l. CrO_3, with the SO_4 ion present in amount from $^1/_{100}$ to $^1/_{200}$ of that of CrO_3, is generally operated at about 45° C. and at 10–15 amp./dm.^{2} The presence of trivalent chromium decreases the range for bright deposits, and its presence is less likely with an antimonial lead than with an iron anode. An alloy of 94% Pb, 6% Sb is preferred.

Cost of chromium plating is due only in small degree to the cost of the metal deposited, but instead to the low current efficiency, some 15%. About 15 times as much current is required to deposit a given thickness of Cr as of Ni. But the decorative coatings are so thin that current costs less than $^1/_4$¢/ft.^{2} Cost of depositing a suitable nickel base coating for reception of a chromium coat is higher than when nickel is to be used uncoated as a better deposit is required. The cost of polishing is greater than the plating cost.

The CrO_3 solution causes sores, especially on the nasal septum, hence, spray carried off by the evolved gas must be taken away right at the source by suction ventilation.

As to future automobile uses, stainless steels are likely to displace chromium plating for nuts and bolts, running board trim, and similar parts subjected to severe abrasion, while stainless-clad duplex steel is promising for bumpers. For radiators and lamps, plating will continue to compete. Use of all these different products in uses to which they are best fitted rather than that of one product for all shiny parts of the car is probable.

On plumbing, it appears better to plate over a preliminary nickel coat than on brass direct. Plating on 18% Ni brass has advantages. Deposits from hotter solutions will probably have better wear resistance. Hydrochloric acid used to clean tile is fatal to Cr plating.

Coatings on zinc or aluminum have better brightness and protective value if deposited over a preliminary coat of nickel than when put on direct. Difficulty of getting true corrosion resistance in a coating of Cr or of Cr over Ni hampers its application to food containers, but no danger is apprehended from presence of traces of Cr salts in food.

The decorative uses of Cr increase the cost of the article plated. Its use for wear resistance prolongs the useful life so the cost is amply justified. The value of chromium plated gages is thoroughly established. It is useful on tube-drawing dies for Cu and Ni. Galling is prevented. It is resistant to wear and corrosion on dies for molded plastics.

Dies for forming operations involving heavy impact can successfully utilize only a very thin Cr coating. On dies for nickel coinage, a thick coating was detrimental, a thin one advantageous. Rolls for forming soft metal foils can well be Cr plated, but not for rolling steel.

Cr plating is useful on knives and saws for wood, rubber and the like, but not on metal cutting tools.

Chromium surfaces on printing plates and on electrotypes for large editions are highly advantageous.

While chromium plate is used on the piston pins of some automobiles, the brittleness of the deposit bars its use from most bearing surfaces, though deposition at higher temperatures may help. Plating the bores of 6-inch guns with 0.0004″ Cr increases life and accuracy.

New uses are likely to be found in service requiring both corrosion and wear-resistance when Cr plating is applied to base metals themselves suitably resistant to corrosion.

* Lecture before the Franklin Institute, Nov. 5, 1931.
** Bureau of Standards.

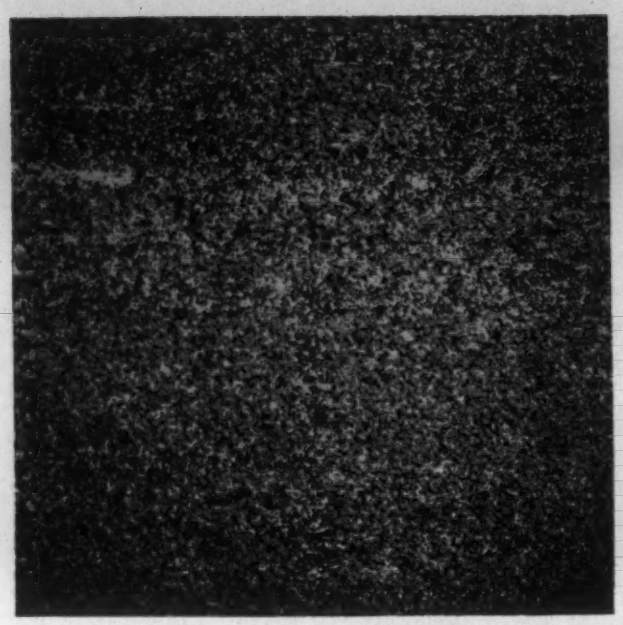


Fig. 1. Copper 79.70, Aluminum 1.96, Nickel 1.25, Zinc (diff.) 17.09. Annealed 500° C. Etched with $NH_4OH + H_2O_2$. 75×.

Fig. 2. Copper 79.70, Aluminum 1.96, Nickel 1.25, Zinc (diff.) 17.09. Annealed 600° C. Etched with $NH_4OH + H_2O_2$. 75×.

Nickel in Aluminum Brass

Condensed from article by W. B. Price by H. W. Gillett

In a pamphlet, "Alcunic Condenser Tubing," privately printed by the Scovill Manufacturing Company, W. B. Price presents 15 curves showing the properties conferred upon aluminum brass of around 20% Zn, 2% Al, 78% Cu by substituting about 1 to 2% Ni for some of the zinc, and raising the copper to about 80%.

The cold-working properties are not much affected by this change in composition, but on annealing at 500° to 600° C., a marked difference appears. Material rolled to 8 numbers hard, annealed and tested at room temperature, gave the following results.

	Al Brass A		Alcunic F		High Zn Alcunic G	
Cu	77.4		80.8		70.6	
Zn	20.0		15.1		25.9	
Al	2.6		2.2		2.1	
Ni	..		1.9		1.4	
	Tensile	Elong. %	Tensile	Elong. %	Tensile	Elong. %
Hard	103,500	3½	107,300	3½	112,600	3
Annealed 500° C.	62,700	46	79,200	25	85,500	23
Annealed 600° C.	54,200	62	69,300	30	72,400	39
Annealed 700° C.	51,500	65	57,400	47	59,700	57
Annealed 800° C.	48,000	62	56,400	52	47,900	53

The very fine structure of alloy E of 80% Cu, 17% Zn, 2% Al, 1% Ni annealed at 500° C. is shown in Fig. 1. This does not at all resemble the recrystallized structure of aluminum brass annealed at 500° C. At sufficiently high annealing temperatures, the usual type of structure appears, as is shown in Fig. 2, though the grain size is smaller than would be the case in the absence of Ni. It is postulated that at 500° there is a precipitation of some nickel compound which would account for the greater strength and lower ductility of the alloy. This suggests the suitability of such alloys for high temperature service. Results of short-time high temperature tensile tests are given below:

	Al Brass B		Alcunic E		High Zn Alcunic G	
Cu	77.3		80.1		70.6	
Zn	20.6		16.8		25.9	
Al	2.1		2.1		2.1	
Ni	..		1.0		1.4	
Temp. of Test ° C.	Tensile	Elong. %	Tensile	Elong. %	Tensile	Elong. %
25	81,500	17	100,500	14	91,600	16
300	55,000	3	85,000	1	65,000	1
500	10,100	63	16,600	40	24,900	4
750	3,300	88	4,200	101	2,700	40
875	1,800	89	2,000	142	650	37

The strength of the alloy E at the higher temperatures is notably improved by the Ni, and at the highest temperatures, the ductility is very high, indicating the good hot-working properties of the alloy.

The high zinc alloy G, unlike the other alloys described, which are all alpha, is a mixture of alpha plus beta. It has high strength but low ductility at 500° C., but its strength drops so rapidly from 600° up that it extrudes with great ease.

The 80% Cu, 17% Zn, 2% Al, 1% Ni alloy is claimed to be especially useful for condenser tubing, as it can be expanded into the tube sheet without splitting, without necessity for torch annealing. It is stated to have less tendency to season crack than the nickel-free alloy, and to be very resistant to corrosion. Beside its adaptability for condenser tubing, it is expected to serve some purposes in the oil industry on account of its high-temperature properties. Comprehensive corrosion tests are under way and are to be reported later. While data on corrosion resistance and an explanation of the exact mechanism by which nickel exerts its influence upon annealing are not yet available, the information so far available indicates a rather specific effect of nickel.

Much more extensive information is given in the curves and tables of the pamphlet than has been included in this review.

Mr. C. B. Woodworth, Manager, Railroad Division, Vanadium Corporation of America, Straus Building, Chicago, Illinois, died suddenly at his home on October 24th.

Mr. Woodworth was graduated in Mechanical Engineering from Purdue in 1907. From then until 1916 he served in the Mechanical Engineering Departments of the Wabash and the Baltimore & Ohio, passing through various grades from machinist to general foreman of the Montclair shops of the Baltimore & Ohio. He then entered the employ of the American Arch Comany with whom he remained until 1918 when he was commissioned Captain of Engineers, U. S. Army. He served fifteen months with the A. E. F. on railroad work in France. Upon his return to this country he joined the Foreign Sales Department of the American Locomotive Company and spent six years in the Argentine and Brazil, engaged in sales and service work. In 1926 he went with the Premier Staybolt Company as special technical representative, from which position he joined the Vanadium Corporation of America in May 1927 as Manager, Western Division. In August 1930 Mr. Woodworth was made Manager of the Railroad Division of the Vanadium Corporation. Mr. Woodworth was buried in Fort Wayne, the place of his birth.

CURRENT METALLURGICAL LITERATURE ABSTRACTS

These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

GENERAL (0)

Status of Alloy Steel Castings. DAVID ZUEGE (Sivyer Steel Casting Co.). *Iron Age*, Vol. 125, May 1, 1930, pages 1294–1296.

According to American Iron and Steel Institute statistics approximately 5% of total American output of steel castings was alloy steel. In 1928 about 14% was alloy steel castings. Largest demand is for small sized castings. Two main groups of alloy steel castings: First group consists of steels having small % of Cr, Ni, V or Mo, also those having Mn and Si in larger quantities than is found in carbon steels. The second group includes those having definite properties and containing usually a high% of special alloying elements. Chrome steels with a C content of 0.35 to 0.55% and Cr content of 0.75 to 1.50% resist abrasion. Complex alloy steels contain about 0.75 to 2% Cr with small % of other elements. Mo is replacing Ni and V in many compositions. Properties of alloy steels have not been developed to the highest degree. VSP(0)

Rare Metals. H. W. GILLETT. *Metals & Alloys*, Vol. 1, August 1930, page 643.

An editorial. Recent observations on copper-beryllium alloy, a market for indium, a German patent on aluminum-gallium alloys, lithium as an alloying element for lead and aluminum, advertised uses for zirconium and tantalum indicates prospect of increasingly greater usefulness of the "Rare Metals." ESC(0)

Recent Metallurgical Research. JOHN S. L. ARCHBUTT. *Foundry Trade Journal*, Vol. 42, April 24, 1930, page 308.

Abstract of paper read before Institute of Marine Engineers in London on "Recent Metallurgical Research in Relation to Marine Engineering." Reviews progress made during the last decade in both ferrous and non-ferrous metallurgy. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. VSP(0)

Research. CHARLES M. A. STINE. (E. I. du Pont de Nemours & Co.) *Mining & Metallurgy*, Vol. 11, May, 1930, pages 261–263.

From address before New York section A.I.M.E. The general public has become "research conscious" to an extent which allows the use of research as a selling point in advertising and has revolutionized our daily life. Capital now employed runs into the billions of dollars. A survey conducted by the National Research Council on the value of research to industry, showed that out of 800 manufacturers only three were of the opinion that it did not pay. Metallurgy is the key industry. Chemical industry is dependent on products of metallurgical industry. In connection with metallurgical research, a close dependence between fundamental and applied research exists. One of the most outstanding tendencies in research consists in greater expenditures for fundamental research. VSP(0)

Chemical Analyses. *Metallurgist*, Aug. 1930, pages 113–114; *Iron Age*, Vol. 125, May 22, 1930, pages 1536–1537, 1578.

Issue is taken with Dr. John Johnston, Director of Research, U. S. Steel Corp. who in an address, "Some Comments on Steel Specifications," before the American Iron and Steel Institute in May emphasized mechanical testing and the treatment of steel rather than close working to chemical specifications. Fine limits in respect to sulphur and phosphorus were particularly challenged, quoting tests of the A.S.T.M. on these elements. The viewpoint of the author is that such tests are not conclusive unless supported by service results and experience. Physical tests in laboratories are not sufficiently imitative of service conditions to allow final conclusions based on them alone. "Dr. Johnston rightly attaches great weight to the effect of the structure of steel on its engineering value, but it is interesting to notice that he appears to be content to allow structure to be judged by the results of mechanical tests, and that he does not directly advocate the examination of that structure—i. e., the use of microscopic examination as a specification test." A steel high in sulphur in which the sulphur, to a large extent, is present in the form of non-metallic enclosures which are drawn out into elongated globules or strings of globules may give satisfactory tensile and impact tests—generally longitudinal tests—but such a bar is ready to fail, e. g., under alternating torsion, because of the effect of the enclosures in initiating fatigue fractures by their "notch action." Phosphorus which occurs in a more or less segregated form in the carbon-free bands of low-carbon steels seriously influences the transformation phenomena in steel and, in conjunction with silicon, may create bands or zones in which no transformation can occur at any temperature, and into which also no carbon can diffuse. Rigid chemical specifications are considered a safeguard of considerable value and should not be relaxed until more conclusive service information is available. For abstract of Dr. Johnston's paper, see *Metals & Alloys*, Vol 1, Oct. 1930, page 791. VVK + VSP(0)

Problems of Steel Plant Metallurgy. WILFRED SYKES. *Mining and Metallurgy*, Vol. 11, May 1930, pages 256–260.

Presented before joint meeting open-hearth conference and Chicago section A.I.M.E., Nov. 1929. Discusses the many and varied problems presented by the blast furnaces, open hearths and blooming mills. Operation of a blast furnace is very complicated. Cites work of R. S. McCaffery on the mineralogical composition of slags and methods of calculation so composition of slags can be determined as mixtures of compound rather than as a gross chemical mixture. Content of scrap used. Investigations needed in the open-hearth are: the determination of the properties of slags and reactions between slags and steel. Another important phase needing attention is rapid tests which will enable the melter to determine condition of heat. Handling of steel in soaking pits can greatly effect quality of the product. Study of the flow of metal during rolling needs further study. Causes of snakes on plates. Importance of research in steel production. VSP(0)

PROPERTIES OF METALS (1)

Radium—(I) Its Nature and Uses. PAUL M. TYLER. *Canadian Mining Journal*, Vol. 51, Sept. 19, 1930, pages 915–918; **(II) Occurrence and Exploitation.** Sept. 26, 1930, pages 869–872.

A summary descriptive of the element, its effect on the views of the constitution of matter, its use in medical therapy and how it is obtained. The ores of radium are uranium ores of three general types: (1) uraninites; (2) niobium-titanium tantalates of the rare earths and uranium; and (3) secondary minerals. The characteristics of each type are noted, also means of extraction of radium salts. The best medical opinion seems to favor the using of radium in large dosages and considers a distribution of larger amounts where competent specialists and well equipped laboratories may be maintained. WHB(1)

Manganese: Its Rise and Progress in Industry. PERCY BONDS. *South African Mining & Engineering Journal*, Vol. 40, Nov. 30, 1929, pages 339–340; Jan. 11, 1930, pages 505–506.

A review. AHE(1)

Rolling and Annealing of Pure Aluminum. (Incrudimento, laminazione e ricottura dell'alluminio puro.) P. TUCCI. *La Metallurgia Italiana*, Vol. 8, May 1930, pages 561–570.

After a brief review of the fundamental principles of rolling industrially pure aluminum, the author gives the results of a series of researches he made at the Royal School of Engineering Torino, Italy. His results show the relation between the mechanical properties of aluminum and the annealing temperature. Aluminum used by the author contained; 0.19% Fe, 0.21% Si, 0.01% Cu, 0.16% Al_2O_3 and 99.43% Al. He states that Al_2O_3 was determined by reduction with hydrogen. Gives a series of comparative curves of tensile strength and elongation of specimen after annealing at different temperatures. It is interesting to note that these properties are mostly affected when the sample is heated to a temperature of about 200° C. GTM(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Aluminium Alloys for Heat-Treated Castings. ROBERT J. ANDERSON. *Metallurgia*, Vol. 2, Aug. 1930, pages 129–132 and 154.

Discusses alloys suitable for heat treating in the cast condition, their metallography, properties and heat treatment. Tables give the mechanical properties of some cast alloys after various treatments. JLG(2)

The Invention and Characteristics of Silumin. W. VON EICHORN. *Chemical Age*, Vol. 23, July 5, 1930, Metallurgical Section page 3.

Abstracted from *Metallgesellschaft*, May 1930, pages 17–21. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 841. VVK(2)

Anti-friction Alloys. (Les Alliages antifrictions.) FRANCOIS ROEKAERT. *Aciers Speciaux, Métaux et Alliages* Vol. 4, Aug. 1929, pages 371–376; 1929, pages 470–482; Dec. 1929, pages 583–589.

The author discusses general properties of anti-friction alloys, tests of anti-friction metals and alloys, different types of anti-friction alloys, alloys with a Sn base, alloys with a Pb base and special alloys. The ternary diagram (after E. Heyn and O. Bauer) of the system Sb–Pb–Sn is given. Many photomicrographs of the alloys are included. Variations in physical properties are shown graphically. Includes bibliography. (2)

Non-ferrous Metals as Conductors of Electrical Energy. (Nichteisenmetalle als Leiter für elektrische Energie.) R. HINZMANN. *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 534–535.

Specifications for copper, bronze, aluminum and aluminum alloys are given, covering allowable impurities, electrical resistance, tensile strength and elongation. The effect of several impurities in various percentages on the properties of copper are given in tabular form. CEM(2)

PROPERTIES OF FERROUS ALLOYS (3)

Cast Iron Refuses to Step Aside. O. W. POTTER. *Iron Age*, Vol. 125, May 1, 1930, pages 1281–1284.

Cast iron has run the gauntlet of the ages and has survived the combined efforts of innumerable alloys and materials to replace it. Structure of cast iron is greatly influenced by Si, C, P, S, etc., and by melting and cooling conditions. Compressive strength of cast iron ranges from 80,000 to 200,000 lbs./in.^{2} Properly made cast iron will have tensile strength of from 25,000 to over 60,000 lbs./in.^{2} depending on its chemical composition and structure. Has high rigidity. Cast iron corrodes about $^1/_2$ as fast as ordinary steel, and only slightly faster than wrought iron. Low abrasiveness and hardness of white cast iron makes it adapatable for car-wheels, brake-shoes, chilled rolls, chilled plows, etc. Strength properties are unaffected by temperatures up to 800° F. Between 800° F. and critical temperature some change of structure but no great change in physical properties. Gray cast iron is probably the only alloy that can function as a bearing without lubrication. Freezes 150° F. below melting temperature. Shrinkage is low. Segregation can be overcome. Heat treating and alloying offer great possibilities for improving cast iron. VSP(3)

Current Progress in Malleable Iron. ENRIQUE TOUCEDA. *Iron Age*, Vol. 125, May 1, 1930, pages 1297–1298.

Comparative tests of malleable iron with steel bolts showed that tensile properties of the former are higher, and resist corrosion better. Most outstanding development in the direction of metallurgical apparatus is the air furnace recuperator designed and built by Carborundum Co. In 23 heats the average coal consumption was reduced from 918 to 591 lbs. per ton of iron melted. Use of electric annealing oven cuts down the time. Rotary melting furnaces are used in Europe. VSP(3)

Nickel Chromium Alloys. JOHN H. RUSSELL. *Metal Industry* (London), Vol. 36, April 4, 1930, pages 377–379; April 18, 1930, pages 429–432; *Journal Birmingham Metallurgical Society*, Vol. 10, July 1930, pages 187–209.

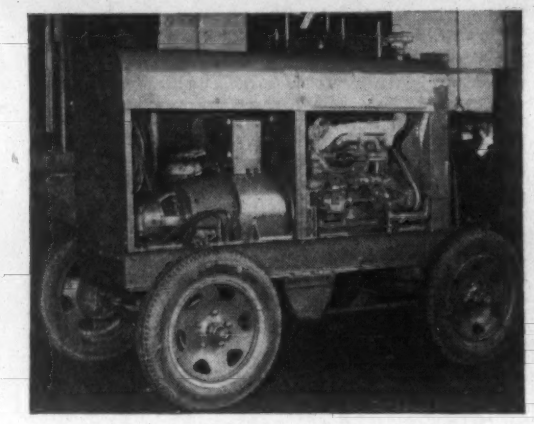
Three classes of Ni-Cr alloys are recognized: (I) the pearlitic group containing up to 8% Cr and Ni in toto. (II) the martensitic group containing between 8 and 20% Ni and Cr, (III) the austenitic group containing up to 25% Cr and Ni. This latter group is divided into two classes, namely, alloys containing over 50% Fe and those containing over 50% Ni. The high Fe alloys begin to show marked brittleness in the region 500–900° C. with a maximum at 700° C. This brittleness persists on cooling. The only way of avoiding this is a carbon free alloy. They resist corrosion of a wide range of mineral and organic acid. Alloys with high Ni are not so resistant to S and HNO_3 but do not possess the brittleness. Of the heat resisting Ni-Cr alloys the 80–20 is the most widely used. English manufacturers add no Mn but American and Continental up to between 1.5 and 2%. A typical alloy, Ni 65, Cr 15, Mn 1, Fe 19, can safely be used as a heating element up to 900° C. in air. The specific resistance of Ni-Cr alloys is 100–110 microhms/cm.^{3} Corrosion resistance is due to protective oxide coating in the first heating. The production is very difficult due to wide solidification range, and a bottom pouring ladle is recommended. Mg is the best deoxidizer. Electric furnaces are used for heating. It is impossible to roll cast ingots so forging must always be resorted to before rolling. A sulphur free atmosphere is required during forging and rolling. The rolling temperature is 1200° C. Wire drawing can be performed as with ordinary steel wire but it is very important that the wire be homogeneous. The highest quality of diamond dies are required and the rate of drawing must be slower than for Cu or Fe wire. Tape is made by passing through flattening rolls. The superficial oxide coating is best put on at the factory rather than after the wire is subjected to use. In casting fluidity may be obtained by adding C, Si or Al. Includes discussion. HCD(3)

New Products

Special 300 Ampere Welders

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces a special type of portable 300-ampere, single-operator welder, for field and street service, which can be towed or transported from job to job at road speeds, thus providing quick and ready transportation. The machine is particularly adapted for use by public utilities, street railways and other concerns whose work is widely scattered.

The standard single bearing 300-ampere, single operator Flex-Arc welding generator is coupled to a four-cylinder gasoline engine operating at 1450 r.p.m. The generator operates on the variable voltage, constant current principle, with a separately excited shunt field. The exciter is overhung from the rear generator bracket. The control which consists of field rheostat, ammeter, and voltmeter is enclosed in a sheet metal cabinet and mounted on top of the generator frame. The four cylinder gasoline power unit has an S.A.E. rating of 28.9 and 42 brake horsepower at 1450 r.p.m.



The power unit, generator, exciter and control are all enclosed in a sheet metal canopy with removable sides. Heavy-duty, pneumatic-tired wheels and spring-borne running gear parts are attached to the welded channel base. The front wheels are steered by use of radius rods and king bolt construction with an adjustable steering rod for hand or trailer service.

The overall dimensions of the complete unit are approximately 93″ × 60″ × 72″ and weighs approximately 3200 pounds.

◆ ◆ ◆

Huge Ore Unloaders at Toledo

Electrically-driven unloaders that pick up seventeen tons of ore at a bite, and that bite every 50 seconds, recently erected on the Chesapeake and Ohio Railroad Docks, Hocking Valley Division, at Presque Isle, Toledo, are the latest step in mechanization of the age-old, time-consuming business of transferring cargoes from ship to shore; and are the first unloaders to be operated by alternating-current.

The vast amount of ore and coal handled by the lake ports has made it necessary and profitable to trans-ship by efficient electrically operated machinery. Docks in Toledo alone last year handled over 16 million tons of coal and almost 2 million tons of ore. The extent of this navigation on the lakes may be judged by bearing in mind that other docks are doing a somewhat similar business.

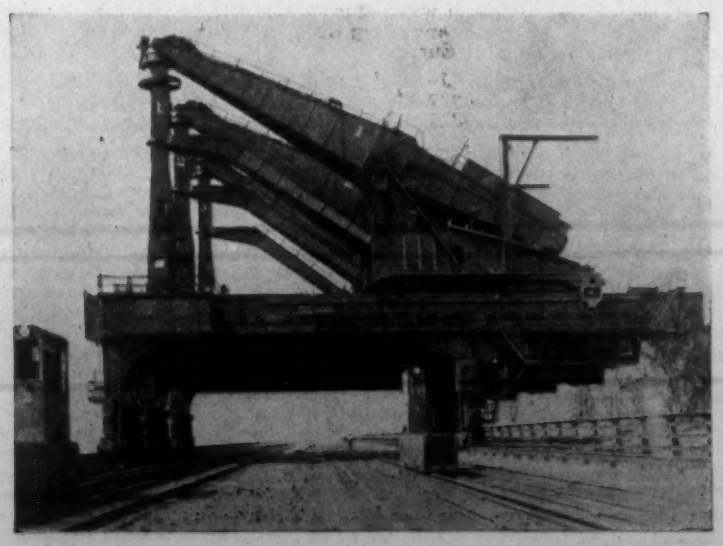


Fig. 1.—The Unloaders Span Four Tracks, and Are Fed by the Lines Seen at the Extreme Right of the Photograph. Pusher Locomotives between the Main Tracks Move the Cars to Be Loaded into Position beneath the Span. One of These Cars Is Seen at the Extreme Left of the Photograph, and the Other Is Shown in about the Center

Although the docks at this particular slip can take three boats, only one at a time can be unloaded with present equipment. Future installations are contemplated. The present installation consists of three stiff-legged hoists, each with a capacity of 1200 tons an hour. With all three unloaders in operation, a boat of beam up to 65 ft. can be unloaded at the rate of 3600 tons an hour. A crew of only three is required for each:—an operator, an oiler and a weigher.

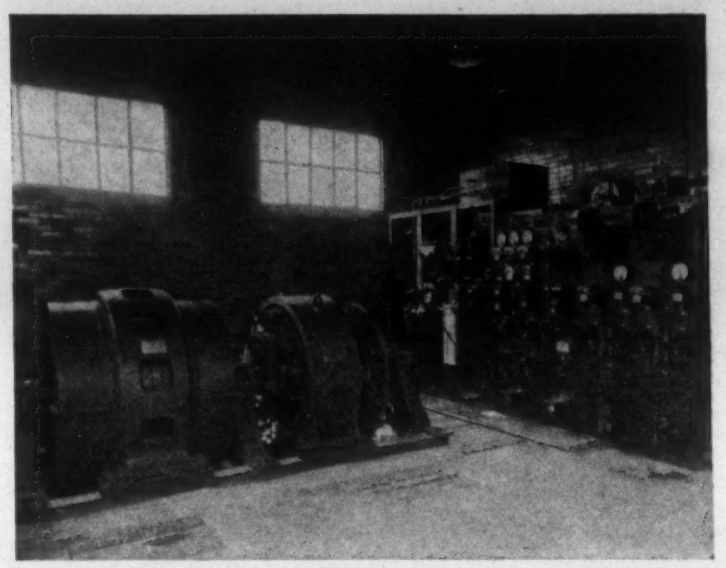


Fig. 2.—The Automatic Substation for the Pusher Locomotives. The Generator Is Rated at 375 Kilowatts

The main structure of each unloader, spanning four tracks, moves on main tracks $72^1/_2$ feet apart, each track measuring two feet, center to center. The forward track is $5^1/_2$ feet from the dock. Travel is about 50 to 75 ft. a minute.

In operation, the dipper picks up the ore from the holds of the boat, and places it in a 50-ton disc hopper which discharges into a travelling scale lorry. This car, in turn, dumps it into any of the four lines of cars beneath the span. Since the ore is too heavy to be dumped on one spot on the waiting car beneath the span, it is distributed by means of a "pusher" car running between each pair of railroad tracks, which, with a lever extending on either side, is able to move the car or train of cars into proper position. This operation eliminates the necessity of moving the span.

The operator rides in a tiny cab directly above the dipper.

There are eight motors totaling 1060 hp. on each unloader. The main motions, beam hoist, and trolley travel are operated by direct current, with variable voltage control; all other operations are handled by alternating current, with full magnetic controllers.

The transformer stations are three-phase, 60 cycle, for 6600 volts incoming, and 440 volts outgoing. The electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company.

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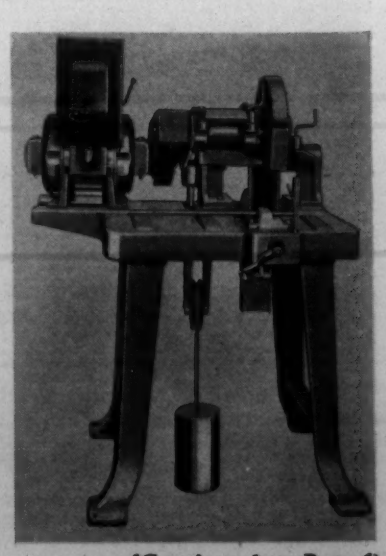
New Abrasive Cut-Off Machine

This machine, manufactured by Andrew C. Campbell, Inc., Waterbury, Conn., is made for cutting steel, steel alloys, iron, non-ferrous metals, fibre and other materials. The cuts are smooth and true. The material is not damaged by heat. There is no danger of drawing the temper of the material cut. The work is held firmly in place by a fixture.



The machine is designed for safety and utility. The handle for operating the disc is arranged so that the operator may use either hand in cutting material. The starting switch is conveniently located on the motor. The belts and the disc are guarded, and there is absolutely no danger of injury to the operator. The moving parts are perfectly balanced so that but little effort is required to operate the machine. The motor is rigidly fastened

(Continued on Page 6)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Protection against Corrosion of Pipes. (La protezione esterna dei tubi metallici contro la corrosione.) A. Rocca. *La Metallurgia Italiana*, Vol. 8, Aug. 1930, pages 757–769.

In this paper, which was presented at the 6th International Congress of Metallurgy, Mining and Applied Geology, Liege, June 1930, the author emphasizes the necessity of protecting water, petroleum and gas pipes against external corrosion. He describes a new lining which is adherent, compact and elastic. This lining consists of many layers of cement and asbestos. GTM(4)

Corrosion of Open Valley Flashings. J. R. Freeman, Jr. *Metals & Alloys*, Vol. 1, July 1930, pages 615–619.

Critical abstract of paper by K. Hilding Beij, Bureau of Standards Journal of Research, Dec. 1929. See *Metals & Alloys*, Vol. 1, May 1930, page 522. ESC(4)

Purely chemical methods for prevention of corrosion of metals. (Les methods purement chimiques de traitement des métaux et alliages contre la corrosion.) Jean Cournot & Jean Bary. *Revue de metallurgie*, Vol. 27, Sept. 1930, pages 479–485.

A brief survey of the methods of coating metals including bronzing of steel and parkerization giving some results of corrosion test in the salt spray on the latter. A mention is made of a new process for protecting Al from corrosion by a process somewhat similar to parkerization invented by Boulanger and giving remarkable protection. JDG(4)

Corrosion of Copper II. (Korrosion von Kupfer II.) L. W. Haase. *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 532–534.

Pure copper is not subject to electrochemical attack. Welded Cu is attacked on account of the oxide formed in the weld, which causes a difference in electrical potential. Soldered Cu acts similarly when immersed in an electrolyte. The solder, except silver solder, dissolves. In the case of silver solder the Cu dissolves. Tinned Cu acts similar to galvanized Fe. The Sn gives good protection as long as the surface is perfect. As soon as it is punctured, electrolytic action begins. The Sn should contain very little Pb. Cu alloys act the same as Cu when soldered. Industrial waters form heterogeneous or homogeneous protection films on Cu. The first are produced by $CaCO_3$ and $MgCO_3$ deposits. These do not affect the metal. The latter are produced by dissolved gases forming an insoluble oxide, sulphide or carbonate on the Cu surface. Water should be analyzed to determine whether Cu will be suitable for tubes or pipe in contact with it. CEM(4)

Corrosion Research. (Korrosionsforschung.) E. K. O. Schmidt. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, July 1930, pages 953–954.

A special meeting of the Deutscher Gesellschaft für Metallkunde was devoted to the question of corrosion on which the author reports in short as follows. G. Masing discussed the principles of corrosion which is understood to be the destruction of the surface of a metallic body by chemical action of non-metallic materials. The process is considered to be of an electro-chemical nature. Schmidt talks of the method for testing corrosion which should imitate absolutely practical conditions. Carius gives some information on the corrosion of copper-clad steel. M. Werner discusses corrosion of lead and its significance for the general knowledge of the corrosion-phenomenon. Brenner reports on corrosion and protection against corrosion of aluminum alloys used in the construction of airplanes. He emphasizes especially that surface protection of light metals is very important as they are not resistant enough when unprotected. R. Sterner-Reiner treats corrosion of cast aluminum-alloys. With increasing purity of pure aluminum also the resistance to corrosion increases. Additions of iron and copper reduce corrosion resistance. Mg, Ti, Si and Zn are neutral, while antimony, bismuth, cadmium and magnesium increase the resistance. H. Roehrig discusses some micro-corrosion tests on aluminum and aluminum alloys and further reports some experiences with electric transmission lines which were exposed to the salty atmosphere near the ocean and the sand storms. Conductors of copper, aluminum, and aluminum alloys after 30 months showed not the least trace of deterioration. Ha(4)

The Passivity of Metals. V. The Potential-Time Curves of Some Iron Alloys. L. G. Bannister & Ulick R. Evans. *Journal Chemical Society*, June 1930, pages 1361–1374.

A study of the nature of oxide films while still adhering to the metal, using an improved method for determining the potential-time curves of different varieties, chemical and thermal treatments, in chromate and chloride solutions. In this method the specimens are placed horizontally, their edges not coming into contact with the liquids. It is found that a metal when covered with a porous oxide film may show any value of potential between that of clean metal and solid oxide. The measured potential will rise when repairing influences prevail (thickening of film, smaller or less frequent pores). The more profuse the rusting of the Fe and steel specimens the lower the initial potential. In general steels which show a final potential above 0.0 v. show no rust at the end of 3 hours, while it is produced by those steels giving negative potentials. The observed potential is not a measure of the rate of corrosion, steel and Al giving about the same final potentials, but the steel being much more quickly corroded. Consideration of the potential-time curves together with the normal electrode potential; gives information consistent with and more extensive than the results of corrosion-velocity measurements. (4)

Metals to Resist Heat and Corrosion. *Metallurgist*, June 1930, pages 83–84.

An extended abstract of a paper by H. D. Phillips appearing in *Heat Treating and Forging* for April 1930. VVK(4)

Heat-Resistant Alloys and Their Behavior to Sulphur. (Hitzebeständige Legierungen und ihr Verhalten gegen Schwefel.) H. Gruber. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, May 3, 1930, page 569.

In order to determine the behavior of different alloys to sulphur, samples were annealed in undiluted hydrogen sulphide and the absorption of sulphur determined after 1 hour at different temperatures. The following table shows the results:

No.	Composition in % Fe	Ni	Cr	Mn	Al	Designation	Increase in weight in g. at 700° C.	800° C.	900° C.	1000° C
1.	100					Iron	0.76	5.51	10	destroyed
2.	75		25			Chromium-iron	0.58	3.18	7.95	13.2
3.		100				Nickel	9.67	35	des.	des.
4.	50	25	25			Iron-Chrome-Nickel	0.43	3.18	8.07	12.5
5.	24	61	15			Chrome-Nickel	0.97	6.79	15.7	31
6.	20	61	15	4		Chrome-Nickel	0.5	3.07	17.6	28
7.	(20	61	15	4)	5	B 5 A	0.31	0.72	9.3	14.1
8.	(20	61	15	4)	10	B 10 A	0.13	0.26	0.55	0.81
9.		90			10	Ni 10 A	0.29	1.26	2.78	10.0
10.	90				10	Fe 10 A	0.33	2.38	19.1	des.
11.	(75		25)		10	Aluminum-Chrome-Iron	0.16	0.7	1.5	6.4
12.			100			Chromium	0.64	1.12	3.2	6.0

Ha(4)

Corrosion and Stress. *Metallurgist*, June 1930, pages 82–83.

A summarizing discussion. VVK(4)

RARE METALS AND ALLOYS

TANTALUM • TUNGSTEN • MOLYBDENUM • CAESIUM • RUBIDIUM

FANSTEEL

now offers

TUNGSTEN

IN ALL COMMERCIAL FORMS

ADJUSTMENT of former patent restrictions now permits Fansteel to offer 99.95% pure Tungsten in rod, sheet, wire, ribbon and powder. Several Tungsten alloys and salts are also available.

Fansteel, of course, has been refining pure Tungsten since 1914, but only for use in electrical contact points. Now manufacturers using Tungsten in other forms are to have the benefit of Fansteel's experience and equipment for refining and working rare metals.

Unusual purity, uniformity and workability are characteristic of Fansteel Tungsten. It has the highest melting point of all metals. It retains rigidity at higher temperatures than any other metal. It has the lowest vapor pressure of all metals, and, in the form of drawn wire, has *greater tensile strength than any other known material.*

The Fansteel research laboratory, with more than 16 years specialized experience in the metallurgy of Tungsten and other rare metals, offers assistance, without charge, on problems of application and fabrication.

FANSTEEL PRODUCTS COMPANY, Inc.

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STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Mechanism of the Solution of Cementite in Carbon Steel and the Influence of Heterogeneity. ERIK WALLDOW. *Iron & Steel Institute, Advance Copy* No. 10, Sept. 1930, 38 pages.

Commercial steels and especially pure Fe-C alloys were intensively studied by thermal and microscopic methods to determine the mechanism of the pearlite change. The transformation of α into γ iron in commercial steels was found to occur successively in different parts of the sample, thus causing the transformation to occur over a range of temperatures. This is explained by the uneven distribution of constituents, particularly Si. Two new forms of hardening structures are reported—hypotroostite and sorbotroostite. Contains 16 references. JLG(5a)

The Cementite Solubility Line. S. EPSTEIN. *Metals & Alloys*, Vol. 1, June 1930, pages 559–561.

A correlated abstract. A complete discussion of the data available at the present time regarding the locus of the A_{cm} line its probable relationship to other factors of the iron carbon diagram, and the available technique suitable for study of the phenomenon. ESC(5a)

Micrographic Characteristics of Light Alloys. (Caratteristiche micrographiche della leghe leggere.) G. GUZZONI. *La Metallurgia Italiana*, Vol. 8, Aug. 1930, pages 747–756.

Sixteen references. The author describes the methods of preparation of micrographic specimens in study of aluminum and its alloys. He also describes the effect of alloying element in aluminum and its structure, color, physical and chemical properties. Alloys studied for which photomicrographs are given are commercial aluminum, Al-Si, Al-Mg, Al-Mg-Si, Al-Cu, Al-Zn, Al-Ni, Al-Mn, Duralumin. For each of these alloys, the author gives a method for preparing, etching, and identifying the structural forms in the alloy. In a summarized table he shows the effect of different etching solutions on each of the investigated alloys. GTM(5a)

Contribution to the Problem of Hardening in Beryllium-Aluminum and Magnesium-Aluminum Alloys. (Beitrag zum Härtungsproblem von Beryllium-Aluminum- und Magnesium-Aluminumlegierungen.) M. HAAS & D. UNO. *Zeitschrift für Metallkunde*, Vol. 22, Aug. 1930, pages 277–279.

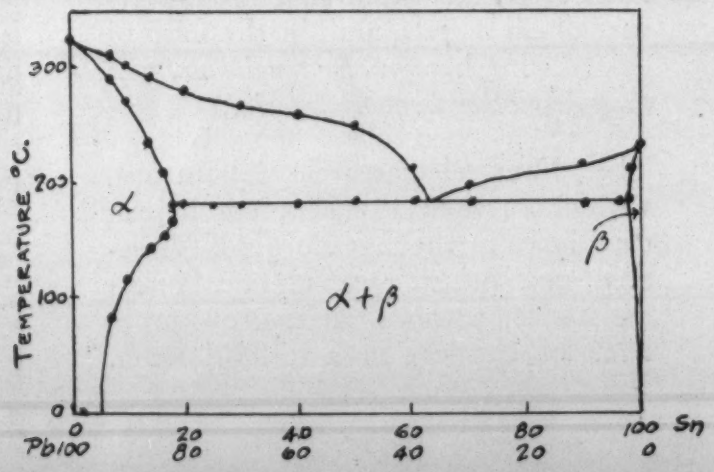
Be-Al alloys with 0.2, 1.0, 1.38 and 1.58 Be were prepared and studied microscopically, dilatometrically, and by means of electric resistance from room temperature to temperatures in the liquid range. It is concluded that the solid solubility at room temperatures is 0.2 Be, at the eutectic temperature 0.8 Be and that the eutectic composition is 1.4 Be. Dilatometric and electric resistance studies were made on Cu-Be-Al alloys with 0.75 Be and 4 Cu, and 1.4 Be and 4 Cu. The results are shown on graphs. Mg-Al alloys were likewise studied dilatometrically, the results confirming the equilibrium diagram of Schmid and Spitaler (*Journal Institute of Metals*, Vol. 35 (1926) page 551.) (5a)

The Structure of Heat-Treated Low Carbon Steel. WELTON J. CROOK & HOWARD S. TAYLOR. *Metals & Alloys*, Vol. 1, June, 1930, pages 539–543.

A practical investigation of 0.20% carbon steel, structural changes when quenched and subjected to various draw temperatures, analyses of samples show presence of copper and nickel. Bureau of Standards analyses of standard steel samples reveals a steady increase in contents of these elements due to use of automobile scrap. Normal transformation points are assumed to indicate no effect by the presence of these constituents. A series of bars was heated for 30 minutes at temperatures beginning at 1300° F. and increasing by increments of 50°. They were quenched in cold water. Regeneration curves, for most steels show a gradual increase in hardness, until the upper critical has been reached and then fell off sharply as it was exceeded. In this case the maximum occurs below the upper critical temperature. Microscopic photographs of these specimens are shown graphically. This indicates a tendency toward martensitization, confirmed by increase in hardness, at 1300° F. At 1350° F. complete transformation to martensite has been effected—Ac_1. At 1450°, this is becoming dilute in carbon and structure is coarsening. At 1500°, a radical change in structure has occurred—Ac_2. At 1550°, the ferrite is completely in solution. Progressive heating above this temperature indicates grain growth of the martensitic structure. A series of test specimens were then heated for various times at various temperatures, tested for Brinell hardness and examined microscopically. A plot of hardness values against draw temperature is shown. Analysis of these photographs reproduced in comparison with temperature is explained. ESC(5a)

On the Equilibrium Diagram of Lead-Tin System. K. HONDA & H. ABÉ. *Science Report of Tohoku Imperial University*, Series I (1930) pages 315–330.

The equilibrium diagram of the lead-tin system has been studied by differential thermal analysis. It was found that the maximum heat evolution at 160° C. lies at 18% of tin. As this temperature is just below the eutectic



point, the heat evolution must be due to a rapid decrease in solubility of β-phase in α-solid solution, with the fall of temperature. The diagram of this system, thus, was greatly simplified as shown in the figure. KT(5a)

Sulphur Prints. *Metallurgist*, Sept. 1930, pages 132–133.

An extended abstract of the paper by M. Niessner in the *Archiv für Eisenhüttenwesen*, Vol. 3, Aug. 1929, pages 157–161. See *Metals & Alloys*, Vol. 1, May 1930, page 523. VVK(5a)

Hot-Working and the Critical Points of Steel. *Metallurgist*, Aug. 1930, pages 116–117.

A critical abstract of a paper by Professor Seigle published in the July 5th issue of *Genie Civil*. Prof. Seigle subjected mild steel bars to severe plastic torsion at a red heat (800° C.) the amount of twist applied being in some instances as much as 1200 complete turns on a length of 100 mm. The specimen of steel was examined both before and after the hot torsion treatment by means of the Chevenard differential dilatometer. The A_3 point was very much intensified and sharpened after twisting. The effect is apparently permanent being retained after fifty cycles. The micro-structure shows no signs of distortion. VVK(5a)

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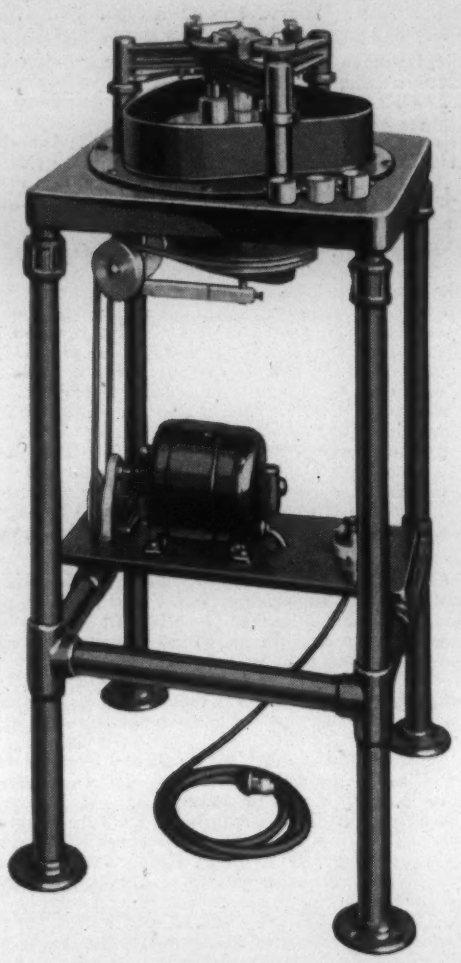

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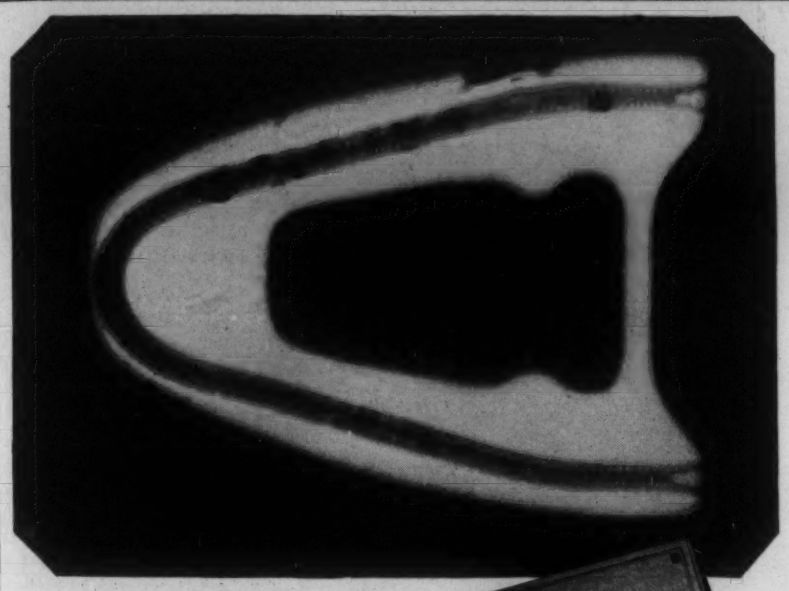

Radiograph of a flat-iron in which a heating unit has been cast. The dark areas indicate blowholes, the result of poor foundry practice, subsequently corrected.

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The Orientation of Rolled Metals of the Hexagonal System. (Ueber die Walztexturen hexagonaler Metalle.) E. SCHMID & G. WASSERMANN. *Metallwirtschaft*, Vol. 9, Aug. 22, 1930, pages 698–702.

Contains 12 references. A piece of technical sheet zinc was cold rolled in one direction to a thickness of 0.02 mm. and X-ray photographs taken at various angles to the sheet in three planes; (1) in the direction of rolling, (2) perpendicular to and (3) 45° to the direction of rolling. The photographs are summarized in a pole diagram showing the position and the intensity of the base faces. The same procedure was followed with a piece of magnesium annealed $1^1/_2$ hours at 600° C. and cold rolled to 0.3 mm. The orientation of Mg is much simpler than Zn. The formation of the orientation of the two metals is explained by the changes in the single crystal, and the characteristic difference by the difference in the mechanical twinning. The heterogeneity of the orientation of rolled Zn is proved by preliminary tests.
CEM(5a)

Atomistic Fundamental Principles of Recrystallization. (Atomistische Grundlagen der Rekristallisation.) U. DEHLINGER. (Technische Hochschule Stuttgart). *Zeitschrift für Metallkunde*, Vol. 22, July 1930, pages 221–223.

Paper presented before the Deutsche Gesellschaft für Metallkunde, Berlin 1930, deals with experiments on recrystallisation due to deformations which are carried to such degrees as to completely change the texture of the starting material. Measurements of recrystallization velocity by determinations of changes in grain size and electrical conductivity showed that at a certain temperature a sudden break in recrystallization velocity occurs. Chaotic small grains or "sliding lamellae" (proven by X-rays to be present in deformed metals) are combining under the influence of temperature to larger, adjacent crystals. This phenomenon is called recrystallization. Based on Prandtl's model of elastic hysteresis, the author assumes that the boundaries of the individual "sliding lamellae" in the deformed metal are hooked together in a metastable manner. This metastable state is overcome by a certain heat energy at a certain energy peak value. The numerical evaluation of this phenomenon proves that at low temperatures this metastable state in the small grains hooked together is abolished gradually, but above a certain temperature abruptly. Additions, the atoms of which are loosely connected with the lattice of the matrix, decrease the recrystallization temperature.
EF(5a)

Some Elementary Facts about Cast Iron. GEORGE M. ENOS. *Metals & Alloys*, Vol. 1, July 1930, pages 595–600.

A general discussion of the effects of carbon in cast iron and its various forms is given. It is observed that the presence of carbon up to the eutectic percentage lowers the melting point of alloys of iron and carbon. The iron-graphite system is termed the "stable system" largely because graphite is released in cast irons upon very slow cooling. It has not been conclusively proved that graphite would be released if only iron and carbon were present in the alloy. For the usual interpretation of structures the "metastable" system, iron-cementite diagram can be used, remembering that graphite may be produced in various ways, and that for convenience in interpretation, the matrix may be regarded as a steel. The rate of cooling of the casting is one of the most important variables in foundry practice. The forms of graphite and cementite have been listed. The influence of silicon, sulphur, manganese, phosphorus upon the iron–carbon system are also discussed at some length.
ESC(5a)

Structure & X-ray Analysis (5b)

Over Annealed Steel is Recognized through X-Ray Spectrometry. H. A. SCHWARTZ. *Foundry*, Vol. 58, May 1, 1930, pages 197–199.

Difficulty may be encountered in distinguishing under microscope steel castings which are not annealed and those which have been annealed. Both may show the Widmanstätten structure. X-ray spectroscopy permits definite conclusions to be reached. Laué method is used. Describes the pattern. Investigation of an as cast steel by Laué Method discloses irregular pattern both as to intensity of rings and as to directional symmetry of asterism. Contains a number of spectrograms.
VSP(5b)

The Iron–Manganese System. *Metallurgist*, Aug. 1930, pages 123–125.

A critical abstract of two papers on this subject; one by Atomi Osawa (*Science Reports of the Tohoku Imperial University*, Series I, Vol. 19, No. 2.) and the other by Einar Ohman (*Zeitschrift für physikalische Chemie*, Abt. B., Vol. 8, Heft $^1/_2$). See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845 for an abstract of the paper by Osawa.
VVK(5b)

A Metallographic Investigation of the Ternary Alloys of Fe–W–C System, Part III. The Equilibrium Diagram of the Fe–W–C System. SHUZO TAKEDA. *Kinzoku no Kenkyu*, Vol. 7, Aug. 1930, pages 409–446.

By means of the thermal analysis, and the microscopic observation, the constitution of the ternary system Fe–W–C, in the temperature ranges above solidus surfaces, was thoroughly investigated and the equilibrium diagram of this system was determined, ranging up to 4% C. In this system, there exist 2 metastable phases θ and η, and 8 stable phases,

$\alpha, \gamma, \delta, \epsilon, \zeta$, graphite, W_2C and WC.
θ composed of compound Fe_3C,
η composed of compound Fe_3W_3C,
α, γ, δ composed of iron,
ϵ composed of compound Fe_2W_2,
ζ composed of tungsten.

The metastable phases are formed on rapid cooling from the melt and change to the stable phases on slow cooling or annealing. As the C content decreases, the stability of the metastable phases increases, and in low C alloys these phases are formed as fairly stable constituents, while in high C alloys readily decompose forming graphite or WC. In the metastable system, among these phases, the following reactions take place:

Monovariant reactions:
Peritectic change, melt $+ \zeta \rightleftharpoons \epsilon$; peritectic change, melt $+ \zeta \rightleftharpoons \eta$;
Peritectic change, melt $+ \epsilon \rightleftharpoons \eta$; eutectic change, melt $\rightleftharpoons \delta + \epsilon$;
Eutectic change, melt $\rightleftharpoons \delta + \eta$; peritectic change, melt $+ \delta \rightleftharpoons \gamma$;
Eutectic change, melt $\rightleftharpoons \gamma + \eta$; eutectic change, melt $- \gamma + \theta$;
Eutectic change, melt $\rightleftharpoons \eta + \theta$;

Nonvariant reactions:
Di-peritectic change, melt $+ \zeta \rightleftharpoons \epsilon + \eta$
Peritecto-eutectic change, melt $+ \epsilon \rightleftharpoons \delta + \eta$, 1380°, 28% W, 1.0% C;
Peritecto-eutectic change, melt $+ \delta \rightleftharpoons \gamma + \eta$, 1335°, 27% W, 1.4% C;
Ternary eutectic change, melt $\rightleftharpoons \gamma + \theta + \eta$, 1085°, 17% W, 3.7% C;
Peritecto-eutectoid change, $\gamma + \eta \rightleftharpoons \alpha + \theta$, 730°, 1.0% W, 0.9% C.

In the stable system, graphite, WC or W_2C take part in the place of the θ and η phases in these reactions. Several changes taking place in the ternary Fe–W–C system are thoroughly elucidated by the double diagrams, stable and metastable systems. Many sectional diagrams, projectional diagrams, a space model showing the equilibrium conditions are shown, the process of crystallization of alloys belonging to several fields of composition are tabulated, and many photomicrographs showing typical structure of respective field were attached.
TM(5b)

to the bed of the machine and is not a part of the counter-balancing arrangement. This results in smoother operation and permits the use of the most efficient size motor to suit the requirements of the installation, resulting in reduced power cost and increased efficiency.

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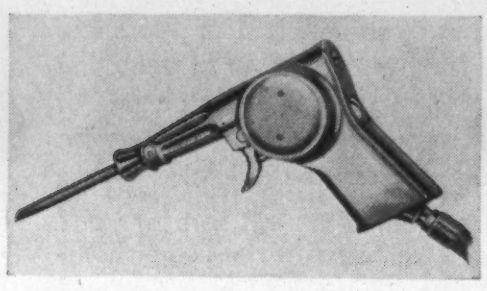
Air Chipper

The Kipp Air Chipper is a new device developed by the Madison-Kipp Corporation of Madison, Wisconsin. It is air driven and operates at air pressures of 60 to 100 lbs. Over 6000 blows per minute are delivered to the chisel through a turbine-valve-hammer mechanism. The chisels are inserted into the barrel and held there by means of a spring clamp. The chisel shanks are pentagon and may be inserted with any of the five sides in an upward position. The chipper itself will operate in any position, giving the operator freedom of action for clearance and convenience. The design of the air chipper eliminates vibration in the grip hand of the operator so that nervous and fatiguing strain, often associated with pneumatic chisels, is absent. The air chipper was developed to provide a substitute for the slow and uncertain hand chipping and grooving in making die casting dies. Early in 1930, the Madison-Kipp Corporation introduced the air grinder, which, like the air chipper, was first used on a variety of work in their die casting die department which this company utilizes as a practical laboratory. The weight of the air chipper is $1^1/_2$ lbs., the length is $5^1/_2$ in.



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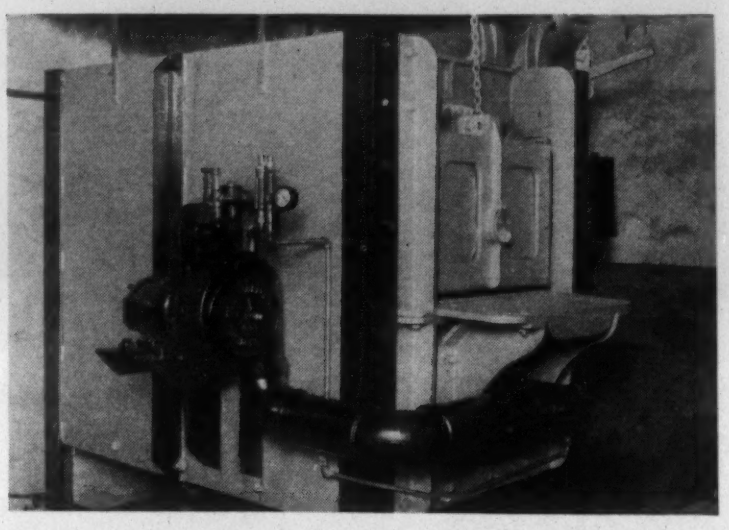
Low Pressure Oil Burner

Ryan, Scully & Company, Philadelphia, have just introduced what is known as their Model DI automatic low pressure oil burner, an equipment which is now under patent application.



The Model DI burner is a self-contained piece of equipment with burner, blower, pump, strainer, regulating valves, atomizer and complete automatic control condensed into one assembled piece of equipment.

This unit is offered to meet small furnace firing conditions in those plants having only one or two units.

W. H. Himes

L. R. Botsai

T. I. Phillips

J. B. Johnson

Westinghouse Promotes Three Men at Nuttall Works

Three changes in personnel have recently been made at the Nuttall Works of the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. **T. I. Phillips**, formerly Superintendent of Metal Stamping at the AB Building, has been appointed Works Manager, succeeding H. A. Houston, who resigned. **W. H. Himes**, who was in the Mechanical Engineering Department at East Pittsburgh, was promoted to the Manager of the Engineering Department. His appointment followed the resignation of L. F. Burnham. The final appointment was that of **L. R. Botsai** as Gearing Apparatus Manager, succeeding E. E. Boon, who resigned. Mr. Botsai was formerly Industrial Manager of the Central District.

◆ ◆ ◆

J. B. Johnson, Chief of Material Branch, War Department, Wright Field, Dayton, Ohio, and a member of the Editorial Advisory Board of METALS & ALLOYS, has been awarded the 1930 Morehead Medal of the International Acetylene Association for original research and development in welded aircraft construction. The presentation was made on the occasion of the Association's thirty-first annual convention in Chicago.

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Walter F. Graham has been appointed Technical Director of the Caskey Brass & Bronze Works, Inc., Philadelphia, agents of the International Nickel Company and producers of nickel, nickel alloy and special non-ferrous castings. Mr. Graham wrote a number of papers on foundry practice while in charge of the Technical Division of the Ohio Brass Company. Some years ago he developed and patented Everbrite metal, a nickel-copper alloy and in this connection served as chief metallurgist of the American Mond Nickel Company.

◆ ◆ ◆

Ralph H. Sweetser, of 2165 Parsons Avenue, Columbus, Ohio, announces his consulting service in Blast Furnace Practice. He will deal especially in problems of raw materials, production and uses of pig iron and coke.

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Stress-Strain Relations in Impact Tests at High Temperatures. *Metallurgist*, Aug. 1930, pages 125–126.

An extended abstract of a paper by T. Sutoki in *Science Reports of the Tohoku Imperial University*, Series I., Vol. 19, No. 1. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

New Conversion Tables Show Relations among Hardness Tests. T. N. Holden, Jr. *Iron Age*, Vol. 126, July 10, 1930, pages 80–81.

Hardness measurement conversion table applicable mainly to alloy steels. Compares hardness obtained with Rockwell using three loads, 150, 100 and 60 kg., with a diamond penetrator. Comparing with latest table of International Nickel Co. the 2 check very closely so far as they go, but this one goes further. May be of use for accurate determination of hardness of thin stock, such as razor blades. Includes table and gives examples. VSP(6)

Railway Rail Progress. H. W. Gillett. *Metals & Alloys*, Vol. 1, July 1930, page 625.

A critical abstract. Detector car tested 2908 track miles and found one fissure per 13.6. It does not detect failures smaller than a nickel. Failures after inspection indicate rapid growth of smaller fissures to failure. Trend of rail failures as projected from 1913–1919 failures led to an expectation of 1 rail failure per 2 miles of track while it actually runs 1 failure per mile due to traffic density. 1.30–1.60% manganese rails are in considerable use to prevent failure. Carnegie Steel, Edgar Thompson Works and Bethlehem are heat treating rails. Pennsylvania reports favorably upon these. ESC(6)

The Pile Temper Testing Machine. R. G. Johnston. *Metal Industry* (London), Vol. 36, March 14, 1930, pages 293–296.

The machine consists of a bed-plate carrying an upright pin, which is rigid and non-rotatable. Around this pin a lever rotates in such a way that it is always tangential to a circle having the pin as a center. Outer end of the lever passes over a quadrant graduated in degrees and carries a vernier enabling tenths of a degree to be read. Behind pin is an adjustable clamp, and along quadrant are holes for insertion of stops. In course of experimental work on successive rolling of Cu without annealing, the Pile test was used and results obtained were plotted. Made by the W.C.T. Avery, Ltd. VSP(6)

Testing Material, Examination of States of Tension in a Plane by Means of Polarized Light. (Werkstoffprüfung, über die Untersuchung ebener Spannungszustände mit Hilfe von polarisiertem Licht.) M. Wächtler. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, April 26, 1930, pages 545–546.

A review of the methods to determine the distribution of plane tensions in structural parts, if subject to mechanical stresses, by means of transparent models. A short description of each method is given and 23 references give the original papers. Ha(6)

The Testing of Cast Iron. J. W. Donaldson. *Metallurgia*, Vol. 2, Aug. 1930, pages 121–124.

15 references. General discussion of methods of testing cast iron. There is considerable controversy as to whether the test bars should be cast separately or cut from the casting. The types of specimens and methods of tests used in various countries are discussed. JLG(6)

Proper Testing of Cast Iron. J. G. Pearce. (British Cast Iron Research Association.) *Iron Age*, Vol. 125, June 5, 1930, pages 1679–1680; *Foundry Trade Journal*, Vol. 42, June 5, 1930, pages 413–416; June 12, 1930, pages 435–439.

Abstract of an exchange paper on "Correlation of Tests for Cast Iron" before the American Foundrymen's Association, Cleveland, May 12. Deals mainly with mechanical tests, usually specified, and with translation from one form of mechanical test to another. Includes discussion. VSP(6)

On the Behavior of Soft Steels When Exposed to Vibrations. (Ueber das Verhalten weicher Stähle bei Schwingungsbeanspruchungen.) K. Aders. *Stahl und Eisen*, Vol. 50, July 31, 1930, pages 1095–1096.

A publication on the behavior of 2 steels (steel W: C 0.08%, Si 0.05%, Mn 0.44%, P 0.023%, S 0.047% and steel S: C 0.07%, Si 0.01%, Mn 0.48%, P 0.036%, S 0.047%) in vibration tests (*Mitteilungen Forschungsinstitut Vereinigte Stahlwerke* (1929) Vol. 1, Report 8, pages 201–221) is reviewed. Steel W was melted under special precautions to produce a steel with slight inclination toward aging effects; steel S was heavily segregated. Both steels were annealed at 950° C. for one hour. The lower yield point for both steels is about the same (W: 24.7 kg./mm.², S: 23.6 kg./mm.²). The values for notch toughness, number of repeated blows before fracture and endurance tensile strength vary very much as shown in the following table. The relation between endurance strength and yield point is evidently different for both steels. This fact was found to be of importance for the reaction of the materials in testing them in a repeated bending test machine as well as of influence on the static physical properties after the steels have been dynamically tested under the application of a dynamic overload. The endurance limit of steel W was increased by 1 kg/mm.² after 5,000,000 cycles with a load analogous to the endurance limit; steel S shows no change. In applying a load 25–33.3% over the endurance limit, the endurance limit of steel W was increased, whereas the endurance limit of steel S decreased. Also the static physical properties of both steels were changed after having been tested dynamically with an overload 25–33.3% above the endurance limit. Yield point and tensile strength of steel S were increased, whereas yield point and tensile strength of steel W was not changed. GN(6)

	Notch Toughness mkg./cm.²	Number of Repeated Blows for Fracture	Endurance Tensile Strength kg./mm.²
Steel W	14.7	17,900	18–19
Steel S	1.9	24,400	24

Damping by the Material at Torsional Vibrations According to the Fatigue Testing Method and the Method of Free Oscillations. (Die Werkstoffdämpfung bei Drehschwingungen nach dem Dauerprüfverfahren und dem Ausschwingverfahren.) W. Knackstedt. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Aug. 23, 1930, pages 1182–1184.

The damping capability of a material has, in recent years, been recognized as a valuable means for judging the behavior of a material in operation. The damping is measured as that work which is transformed into heat in 1 cm.³ of material at a full cycle of load within the limits + maximum stress to − maximum stress. Three methods are in use for determining this energy: (1) the static hysteresis-loop, determined as a function of the deformation in a cycle process; (2) the fatigue test, determined by the energy supplied by the driving engine; (3) the free oscillation test—the test rod is provided with a heavy mass and made a springy member of a vibrating system and the oscillations are damped by the damping capacity of the material. The logarithmic decrement of the vibrations permit the direct determination of the energy of deformation. The machines for these 3 methods have been developed in the Wöhler Institute in Braunschweig; these, together with the methods, are described and illustrated. Tests show that the results from the 3 methods do not differ greatly. 5 references. Ha(6)

Zinc Coatings and the Corrosion Fatigue of Steel. *Metallurgist*, June 1930, pages 86–87.

A summarizing review of the recent work on the effect of protective coatings on corrosion fatigue. VVK(6)

Corrosion-fatigue of Metals. (Die Korrosionsermüdung der Metalle.) D. Thoma. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, May 31, 1930, page 719.

The observation first made by McAdam that the fatigue tensile strength of a sample rod is reduced if its surface is moistened with water during the fatigue test, has been confirmed by new tests of the author who calls attention to the importance of this fact particularly for the design of machines. He made two tests with 3500 alternate bendings in one minute, one with an electric steel casting of 65 kg./mm.² tensile strength which had a dry fatigue strength of 21 kg./mm.², and when moistened by a water-jet of low speed gave only 14 kg./mm.². The other test with rustless steel of 66 kg./mm.² tensile strength showed an endurance limit of 24 kg./mm.² dry and 14 kg./mm.² when wet. The first steel showed strong corrosion (rust) while the other did not show the least trace of rust. Ha(6)

Fatigue of Aluminum Alloys. *Metallurgist*, Sept. 1930, pages 137–139.

A very extensive critical abstract of the work of Johnson and Oberg reported in the *Proceedings American Society for Testing Materials*, Vol. 29, II (1929) page 339. VVK(6)

Fatigue Tests of Fillet Welds. R. E. Peterson & C. H. Jennings. *Engineering*, Vol. 130, Aug. 29, 1930, page 281.

Abstract of paper before the American Society for Testing Materials, June 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846.LFM(6)

Endurance Studies with the Schenck High-Frequency Tension-Compression Machine. (Dauerversuche an der Hochfrequenz-Zug-Druck-Maschine. Bauart Schenck.) K. Memmler & K. Laute. (Staatliche Materialprüfungsamt Berlin-Dahlem.) Heft 329, Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, V. D. I. Verlag, Berlin (1930) 32 pages. Paper 6 RM.; *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Feb. 8, 1930, pages 180–190.

A magnetically-driven axial loading endurance testing machine of the same general type as the English Haigh machine, but operating at a much higher speed, 30,000 cycles/min., is described. At this speed, it takes but 5½ hours to run the 10 million cycles to which it is customary to extend an endurance test. Many difficulties, such as the danger of error in stress calculations due to resonance, the difficulty of calibration, the necessity of knowing the modulus of elasticity in order to calculate the load from the amplitude, that of choosing specimens of proper dimensions for each material to be tested, etc., etc., are discussed. For materials of high "damping," which develop heat during the test, an oil spray is provided to cool the test piece. Results are given on steels ranging from 0.05 to 0.80% C, in several conditions, on silicon steels from 0.10 to 0.20% and about 0.90% Si, on a 0.45% C, 4% Ni, 1% Cr, 0.80% W steel, on cast iron, nickel, copper, an Al-Cu-Si alloy (Lautal), an Al-Cu-Zn Mn, Li alloy (Scleron), and a 90% Mg, 10% Al alloy (Electron). The S-N curves had the usual shapes for the various materials studied, and the effect of understressing was quite normal. The effect, expressed in maximum amplitude of deformation of the test piece that could be withstood indefinitely, of a surface notch 0.03 mm. deep, turned on the test section was found to be a reduction of 22% for the heat-treated Ni Cr steel, 15% for the same annealed, 28% for annealed 0.05% C steel, 10 to 22% for various as-rolled steels and zero for annealed nickel and for copper as rolled. That is, the materials did not act quite as would be expected from low-frequency tests in this respect. The ratios of endurance limit to tensile strength were extraordinarily high. Ratios of 45 to 55 to which one is accustomed for steel in endurance testing at ordinary speeds, were found with some of the harder steels, but the softest steels showed ratios as high as 70 to 75 or even more. Lehr previously found much higher endurance limits on this high speed Schenck machine than at slow speeds. Some speculation is given on whether this is a real phenomenon and the authors conclude with the remark that a comparison of the same materials on this and other endurance machines must be made before the usefulness of this can be determined. Such work is to be undertaken at the Materialprüfungsamt. From the comments of the authors on the usual ways by which attempts at short cut methods of endurance testing are carried out, it would appear that they do not consider any of them of any promise and have turned to this very high speed machine as more hopeful. Since, on the face of the returns, the endurance limits determined at 30,000 cycles/min. appear to be very much on the unsafe side, unless further work shows systematic errors in methods of calibration that can be corrected, or unless an absolutely reliable proportionality factor between such results and those that would be obtained at the speeds at which the materials are actually used in service can be worked out, the utility of the apparatus would appear very doubtful. From the description, the machine would appear to require a very skilled operator, very careful determination of the elastic modulus, to be very noisy, and very expensive. Many of these drawbacks could be put up with if endurance testing could be hastened, but this type of testing machine will require much more research in "testing the test" before the speeding up of endurance testing can be taken as accomplished. The account will prove most interesting to those working on endurance testing methods. Whether any of the data so far obtained with the high-speed machine can as yet be safely used for any purpose of engineering design, seems very doubtful. HWG&Ha(6)

Compressive Tests of Bases for Subway Columns. James H. Edwards, H. L. Whittemore & A. H. Stang. *Bureau of Standards Journal of Research*, Vol. 5, Sept. 1930, pages 619–625.

In the construction of subways under the streets for carrying passengers by electric trains it is customary to provide steel columns between the tracks to support the overhead structure. These columns are usually rolled steel H-sections having plate and angle bases riveted to the columns for distributing the load on the concrete footing. Tests were made of 3 welded bases and 6 riveted bases, 3 without base plates and 3 with base plates to determine whether the welded design was satisfactory. The specimens were loaded with the base on a span of 12 inches. Some hand strain-gage readings were taken to study the stress distribution. The strength of the welded specimens and the riveted specimens having base plates was practically the same. The H-section deformed greatly at the maximum load, and the stiffeners in the base buckled. The strength of the riveted specimens without base plates was about 60% of the strength of the other types. At failure, 8 rivets on one side of the specimen sheared. There was apparently no deformation of either of the H-sections or the angles forming the base. (6)

Seams for Copper Roofing. K. Hilding Beij. *Bureau of Standards Journal of Research*, Vol. 5, Sept. 1930, pages 585–608.

The various types of seams which have been proven by experience to be suitable for copper roofing are described. Leakage tests showed that calked seams can be used wherever the depth of water which may be standing for several days on the roof will not exceed 4", a depth rarely occurring except in gutters. A small section of seam removed from a roof after many years of service stood continuously for 45 days under 12" of water without any signs of leaking. The tests proved that the maximum strength is secured by pretinning, and large quantities of solder on the exposed surface of the seams are of little value. The results of prolonged tests indicated that the maximum safe load for soldered lap seams is about 350 lbs./in.² of seam and about 375 lbs./in.² pretinned flat-lock seams. Under greater loads failure occurs after a time, depending upon the magnitude of the load. (6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Plating Stainless Steel. W. E. WARNER. *American Machinist*, Vol. 72, May 29, 1930, page 884.

Ordinary plating solutions are not successful for plating stainless steel with silver, copper or nickel. A good solution is one of 25% sulphuric acid. Use a lead rod as an anode and the steel as the cathode. Voltage of from 4 to 6 volts. Solution temperature from 10 to 80° F. Another solution is one of 30% hydrochloric acid. Use a carbon anode, same voltage as before, and a temperature of 140° F. RHP(7a)

Continuous Electro-Deposited Tubing. *Metallurgist*, July 1930, page 110.

The method of Prof. Billiter in producing continuous electro-deposited tubing as presented to the American Electrochemical Society in May, 1930 is described. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 796. VVK(7a)

Hardness and the Polishing of Electrodeposits. D. J. MACNAUGHTON & A. W. HOTHERSALL. *Metal Industry* (London), Vol. 36, Mar. 21, 1930, pages 321–332; Mar. 28, pages 351–354; Apr. 11, pages 410–412.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 841. VSP(7a)

The Contamination of Solutions. F. J. LISCOMB. *Metal Industry* (N. Y.), Vol. 28, Sept. 1930, pages 427–429.

The introduction of iron into alkaline cleaning and electroplating solutions is discussed, together with means employed to determine the sources of the contamination and the contaminating influences. All pickled work should be well neutralized and thoroughly rinsed in clean water before going to a plating tank, and tanks should be rubber lined. Cleaning and alkaline plating solutions should be free from all chlorides. Unlined tanks should never be used as anode in any cleaning or plating solution. All electric cleaning and plating solutions should be tested with steel electrodes to note any attack under the influence of the electric current. Sodium ferrocyanides does not interfere with anode corrosion in acid-copper solutions, except when free cyanide is low and the current density high. When sodium cyanide is used, only a high quality should be considered. Ammonium chloride should not be used in acid-copper solutions. WHB(7a)

Protective Value of Some Electro-Deposited Coatings. L. DAVIES & L. WRIGHT. *Sheet Metal Industries*, Vol. 4, May 1930, pages 27–31; *Metal Industry* (London), Vol. 36, Apr. 11, 1930, pages 407–410.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 797. VSP+AWM(7a)

Addition Agents in Copper Electrotyping Solutions. R. O. HULL & W. BLUM. *Bureau of Standards Journal of Research*, Vol. 5, Sept. 1930, pages 767–773.

The effects of various addition agents in copper electrotyping solutions were investigated. It was found that phenol in the form of phenolsulphonic acid is most satisfactory. Its use permits the electrotypes to be produced in much shorter time, and to be harder than those obtained in ordinary baths. (7a)

Electrometallurgy (7b)

The Electrolytic Zinc Plant of the Evans-Wallower Company at East St. Louis, Ill. U. C. TAINTON & DANIEL BOSQUI. (The Evans-Wallower Zinc Co.) *Canadian Mining Journal*, Vol. 51, Aug. 28, 1930, pages 769–771.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 798. (7b)

Electrolysis of Molten Silver Lead Alloys. (Ueber die Schmelzflusselektrolyse von Silver-Blei-Legierungen.) ROBERT KREMANN, BORIS KORTH & ESTHER INGE SCHWARZ. *Monatshefte für Chemie*, Vol. 56, July 1930, pages 16–25.

Contains 4 references. The alloy 35% Ag, 65% Pb was melted and poured into capillary tubes of refractory material and electrolyzed for 6 hours at current densities ranging from 7.64 to 18.11 amps./mm.^{2} Temperature of the alloy reaches 1000° C. After cooling the rod was cut into sections and the individual sections analyzed for Ag content. Ag tends to migrate toward the cathode and Pb toward the anode. With the lower current Ag ranged from 33.85% at anode end to 43.10% at cathode end. With highest current from 44.05% to 53.05%, the higher Ag content being due to some of the Pb volatilizing at the higher temperatures. CEM(7b)

Experiments on the Electrolysis of Bronzes with Silver Additions. (Versuche über die Elektrolyse von Bronzen mit Silberzusätzen.) ROBERT KREMANN & ESTHER INGE SCHWARZ. *Monatshefte für Chemie*, Vol. 56, July 1930, pages 26–34.

Contains 4 references. Bronze containing 29% Cu and 71% Sn with additions of 1.3 to 10.8% Ag was electrolyzed for 4 hours at 2.5 to 5 amps./mm.^{2} according to the process previously described. Cu and Ag tend to migrate to the cathode and Sn to the anode. Photomicrographs show the structure of different sections of the electrolyzed rods. CEM(7b)

Experiments on the Electrolysis of Bronzes with Lead Additions. (Versuche über die Elektrolyse von Bronzen mit Bleizusätzen.) ROBERT KREMANN & WALTER PIMETZ. *Monatshefte für Chemie*, Vol. 56, July 1930, pages 71–78.

Contains 2 references. Bronze containing 28% Cu, 49 to 69% Sn and 21.6 to 2.9% Pb was electrolyzed for 4 hours at 2.2 to 6 amps./mm.^{2} according to the process previously described. Cu tends to migrate to the cathode and Sn and Pb to the anode. Photomicrographs show the structure of different sections of the electrolyzed rods. CEM(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Bending Conditions of Galvanizing. HEINZ BABLIK. *Iron Age*, Vol. 125, May 15, 1930, pages 1452–1454; May 22, pages 1528–1531.

Good bending qualities are important for galvanized sheets and wires. Experiments show that Zn on very small discontinuities can afford a protection when there is an electrolyte of very good conductivity. This is true only when two conditions exist. First that the discontinuity is very small and second that Zn coating is thick. Rust protection is given only when a compact layer of pure Zn covers the iron base. Gives results of other investigators. Galvanizing coating should not break nor peel off under bending conditions. Lengthening of pure Zn layer is dependent on bending radius and thickness of sheet. Calculation shows that lengthening $\epsilon = h/2R$ becomes greater as sheet is thicker and bending radius smaller. Describes and illustrates formation of Zn and alloy layers. "Galv-annealing" is accomplished by placing a strong alloy between Zn layer and the Fe. Thick coatings versus thin coatings. If Fe-Zn alloy layer is small, bending quality is good, while if it exists to any noticeable degree bending is bad. Good bending can be secured by alloying Zn bath with Al. VSP(8)

The Testing of Zinc Coatings. *Metallurgist*, Sept. 1930, pages 131–132.

An extended abstract of the article by E. H. Schulz appearing in *Stahl und Eisen*, Vol. 29, July 17, 1930, pages 1017–1022. The paper is criticised on the basis of, after giving a very extensive comparison of tests, no correlation is made with service conditions and the real problem of serviceable accelerated testing has made no progress. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 848. VVK(8)

Protective Coatings for Iron and Steel. I. Metallic Coatings. HENRY N. BASSETT. *Industrial Chemist*, Vol. 6, June 1930, pages 241–243.

This is a review containing much interesting information. In addition to protective coatings obtained by the processes of Barff, the Bowers, Gesner, Tatlock and Coslett are dealt with briefly. (8)

The Destructive Action of Molten Zinc, at and above Zincing (Galvanizing) Temperatures, upon Metals and Alloys. IX. The Action upon Tin, Lead, Cadmium, Arsenic and Antimony. WALLACE G. IMHOFF. *American Metal Market*, Vol. 37, Sept. 9, 1930, page 10. **X. The Action upon Aluminum, Magnesium, Cobalt, Platinum, Gold and Other Rare Metals.** Sept. 27, 1930, pages 5, 10; Oct. 1, 1930, page 10.

This discussion centers largely around the influence of the various soft metals in the galvanizing bath, their influence on the spangle, the alloys formed with zinc, and their influence upon the temperature of the bath, the fluidity of the bath and adherence of the zinc coating. Tin is used in the galvanizing bath to open up the spangle and give the sheet a bright, smooth finish. Conditions affecting the crystals are: (1) temperature of the zinc bath; (2) the submersion time; (3) the additions of metals to the bath (tin, etc.); (4) the time of cooling; (5) the iron content of the bath; (6) the quality and analysis of the steel base; (7) the smoothness of the surface, and (8) the pickling conditions. In the metalware industry the amount of tin added to the galvanizing bath is proportional to the surface area coated. Lead acts as a lubricant material, cadmium tends to lower the melting point of the bath and to make it thinner and more fluid. Used in the proper amounts with other alloying metals a very beautiful spangle can be developed. Little is known of the effects of arsenic and antimony though the latter in excess produces a yellow stain, and coatings peel and flake much easier than without it. Aluminum alloys readily with zinc, and any excess will come to the surface to form an undesirable scum. The chief function of aluminum in zinc baths is to keep down surface oxidation. Its amount is dependent upon the size of the kettle, the amount of material put through the bath, the bath temperature, the number of times the surface of the bath is skimmed when each article is withdrawn, the way it is put into the bath and the operator. Very little is known of the effect of magnesium on galvanizing baths, and cobalt dissolved in zinc to a slight extent. It might be sprayed on the inside of the galvanizing pots. WHB(8)

Copper-armored Steel "KPS" for Transmission Lines of Medium Voltage. (Kupferpanzerstahl "KPS" als Leitungsbaustoff in Mittelspannungsnetzen.) H. MARZAHL. *Elektrotechnische Zeitschrift*, Vol. 51, Oct. 2, 1930, pages 1395–1396.

This material consists of a steel core on which a copper cover is insolubly welded in vacuum. The copper is cast around a white-hot steel block. The ratio of the section of the two metals always remains the same in all the following rolling and drawing processes. The table gives comparative figures:

	KPS-wire	Copper wire
Weight in kg./cm.^{3}	8.22×10^{-3}	8.9×10^{-3}
Tensile strength in kg./mm.^{2}	65–70	40
Elasticity modulus, kg./mm.^{2}	15000	13000
Linear expansion coefficient for 1° C	1.35×10^{-5}	17×10^{-5}
Temperature coefficient for 1° C.	4.05×10^{-3}	3.7×10^{-3}
Specific conductivity at +20°C. in $\frac{m}{\text{Ohm mm}^2}$	19.5	55

Cost for installation and maintenance for KPS lines are lower than for copper under equal conditoins, and the safety against breaking is greater. Ha(8)

INDUSTRIAL USES AND APPLICATIONS (9)

Effects Large Savings by Chromium Plating Gages and Tools. *Iron Trade Review*, Vol. 86, Feb. 27, 1930, page 62.

From *Ford News*, Jan. 15, 1930. Ford Motor Co. has applied hard Cr plate to gages and machine parts resulting in important savings in time and costs. Plate gages formerly giving only 4 hrs. in certain grinding operations, now give 218 hrs., while a gage used on the small end of the connecting rod, could be used only 1300 times before plating. After plating this increased to more than 1800 holes. On tool fixtures, the parts show a saving of from 6–20 times after plating. Ms(9)

Principle and Uses of Wire Rope. Part VIII. WALTER A. SCOBLE. *Metallurgia*, Vol. 2, June 1930, pages 63–64; Sept. 1930, pages 183–184.

Lubrication of wire rope and causes of corrosion are discussed in detail. Graphite and similar opaque lubricants may cause excessive sliding of cables on traction-drive elevators and also interfering with the thorough inspection of the rope. Boiled linseed oil, applied hot, will saturate the hemp center, and will when dry, give a transparent covering. Corrosion may be due to the internal effect of incorrect preservative materials, or of excessive moisture in the fibre core. It is recommended that the fibre core be impregnated with lubricant by passing it through a bath containing a heated mixture of oil and petroleum jelly, as a protective against the subsequent absorption of moisture and as a reservoir for the lubrication of the internal wires and strands of the rope. GTM(9)

Chrome-Nickel Alloy Finds Varied Uses in Unusual Products. GEORGE S. HERRICK. *Iron Age*, Vol. 125, June 12, 1930, pages 1735–1737.

Describes various products made of Cr-Ni non-corrosive alloys by the Pressed & Welded Steel Products Co., Long Island City, N. Y. VSP(9)

Wire Cable Compacted by Stretching It Beyond Working Load. C. C SUNDERLAND. *Iron Age*, Vol. 125, June 12, 1930, pages 1748–1749.

Taken from *Engineering News Record*, May 1, page 714. Strands worked into close contact reduce the springiness and result in an increased modulus of elasticity. Structural stretch is not a definite quantity but is variable. Proper manufacturing tension and pressure assure uniformity of elastic properties. Describes the method used by the J. A. Roebling's Sons Co., Trenton, N. J. VSP(9)

The Use of Non-Ferrous Metals in the Aeronautical Industry. D. HANSON. (University of Birmingham.) *Institute of Metals, Advance Copy* No. 545, Sept. 1930, 24 pages; *Engineer*, Vol. 50, Sept. 12, 1930, pages 291–293; *Metal Industry* (London), Vol. 37, Sept 12 (1930) pages 247–249, 252; Sept. 26, 1930, pages 295–296; *Engineering*, Vol. 130, Sept. 12, 1930, pages 333-334.

Lecture before the Institute of Metals on Sept. 9, 1930. Considers chiefly the alloys of aluminum and of magnesium now used in the aeronautical industry. Magnesium in comparison with aluminum is inferior in that it has a lower modulus of elasticity and is not as resistant to corrosion. LFM + JLG(9)

The Application of Aluminium for Textile Machinery. D. L. PELLATT. *Metallurgia*, Vol. 2, Aug. 1930, pages 143–144.

Aluminum and aluminum alloys, especially as castings, are used for many parts of textile machinery. JLG(9)

Progress in the Manufacture of Alloy Steel. S. J. HEWITT. (Edgar Allen & Co.) *Sheet Metal Industries*, Vol. 4, Aug. 1930, pages 287–288.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 798. AWM(9)

Some Characteristics of Light Alloys for Aircraft. H. W. GILLETT. *Aeronautical Engineering, American Society of Mechanical Engineers Transactions*, Vol. 52, Sept. 1930, pages 115–120.

Bibliography of about 50 references. Discusses the advantages and disadvantages of Be, Mg and Al, and their alloys in aircraft. Deals with cost and production, mechanical properties of strong light alloys as compared with those of alloy steels, metal propellers, effect of welding and heat treatment, corrosion, protective coatings, castings, die castings and forgings. MS(9)

HEAT TREATMENT (10)

The Conditions of Drop Forging, Overheating during Drop Forging, and Regeneration by Thermal Treatment of Cementation Nickel-Chrome Steel. (Le conditions de matriçage, la surchauffe positive au cours de matriçage et la régénération par traitement thermique de l'acier nickel-chrome de cémentation.) E. DECHERF. *Aciers Speciaux, Métaux et Alliages*, Vol. 4, Nov. 1929, pages 527–543.

A complete discussion is given together with new data, sketches, and photomicrographs. (10)

Practical Heat-Treating in the Small Shop. ARTHUR MUMPER. *American Machinist*, Vol. 72, April 24, 1930, pages 699–700.

Oil-hardened alloy steel should be heated to about 1,375° F. and quenched in an acid bath, and immediately drawn in an oil or salt bath to the desired temperature. Steel should be pre-heated to about the temperature of the furnace. If put in while cold the rapid expansion usually causes distortion. Describes the construction of a hot plate which the writer has used for preheating as well as drawing. Non-shrinkable, oil hardening steels should often be drawn longer than may seem necessary. Too short drawing time means the risk of cracks or distortion developing in a short time. RHP(10)

Recrystallization. (Ueber die Rekristallisation.) G. TAMMANN. *Zeitschrift für Metallkunde*, Vol. 22, July 1930, pages 224–226.

A general discussion of Tammann's views upon recrystallization under hardening; the formation of recrystallization nuclei; intercrystallization material; grain boundary displacement; repeated recrystallization; influence of cooling velocity; variation in grain size in recrystallization metals. EF(10)

Case Hardening & Nitrogen Hardening (10c)

Accurate Case-hardening. H. SWAIN. *Metallurgia*, Vol. 2, Sept. 1930, pages 185–186.

General discussion of the case-hardening process, emphasizing the importance of the effect of tempering temperature in case-hardening steel as given in the following table:

Steel	Not Tempered	Diamond Hardness Number Tempered at 100° C.	150° C.	200° C.
A	970	970	890	825
B	970	940	890	800
C	768	768	735	687
D	825	825	768	735

GTM(10c)

Nitriding Steel. *American Machinist*, Vol. 72, May 1, 1930, page 741.

Steels best suited to nitriding are those containing 0.72 to 1.25% Al and 1.00 to 1.50% Cr, with 0.20% Mo. These are manufactured under the trade name "Nitralloy" in C contents ranging from 0.20 to 0.40%. Gives very briefly the history, process precautions, finishing, advantages and present uses of the nitriding process. RHP(10c)

Quenching (10d)

The Effect of the Rate of Cooling on Steel. J. M. ROBERTSON. *Chemical Age*, Vol. 23, July 5, 1930, Metallurgical Section, pages 1–2.

A general survey of the effect of the rate of cooling on the structure and constitution of steel, of which this is an extended abstract, is given in Paper No. 59 of the Safety in Mines Research Board (H. M. Stationery Office, 2s. net.) VVK(10d)

On the Influence of the Cooling Velocity on the Transformation Points, the Structure and the Atom Structure of Iron-Carbon Alloys. (Ueber den Einfluss der Abkühlungsgeschwindigkeit auf die Temperatur der Umwandlungen, das Gefüge und den Feinbau der Eisen-Kohlenstoff-Legierungen.) F. WEVER & N. ENGEL. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12 (1930) Report 150, pages 93–114; *Stahl und Eisen*, Vol. 50, Sept. 11, 1930, pages 1308–1311.

This investigation was undertaken to determine what changes take place in the Fe-C equilibrium diagram under gradually increased cooling conditions, i. e., the relation between thermal effects observed during the quenching of a steel and the phase limits of the Fe-C diagram should be elucidated. These effects were studied in straight C steels with only very small amounts of Si and Mn. Furthermore electrolytic Fe was examined, which had picked up small amounts of C during a re-melting. N. Engel designed a special apparatus for the quench tests. The temperature was measured by means of Pt-Pt Rh thermo-couples, which registered the reading on a Siemens and Halske cardiograph. Even for the highest cooling velocities used the time-temperature course was excellently registered. In order to increase the sensivitity of the method an arrangement was furthermore developed to register the cooling velocity-time curves of the quenched samples. The results are: The A_3 point is lowered in pure Fe with increasing cooling velocity, first rapidly, later gradually. For the highest cooling velocity employed, 10,000° C./sec., the transformation is lowered to about 580° C. and nearly wiped out. No other effects occur. In very low carbon steels (0.037%) another effect (point M) appears at about 440° C., for cooling velocities above 5300° C./sec., besides the lowered A_3 point. The effect at M increases in favor of A_3 by slightly increasing the cooling velocity, so that finally only the effect at M is observed. For C contents above 0.3% the A_3, A_2 and A_1 points can no longer be distinguished, even at small cooling velocities. These points appear as one effect after an undercooling effect (recalescence). At higher cooling rates M also appears. The effects in hyper-eutectoid steels are similar. Point M is lowered with increasing C content and increasingly loses its significance. In a 1.8% C steel point M is but faint at 120° C. The results on the thermal effects have been plotted in a concentration-temperature, cooling velocity diagram which is discussed in detail. The structures correspond to this diagram. The quenched samples of pure Fe contained always a 100% homogeneous, polyhedric structure. At sufficiently high cooling rates needles of martensite appear. With increasing C content the relation between thermal history and structure becomes more and more significant. As to the influence of the cooling rate on the atomic structure the following was stated: Interferences of a cubic space centered crystal are observed in samples up to 0.4% C. These interferences decrease with increasing C content and are shifted sidewise either way, which can be explained by the slowly appearing tetragonal distortion of the lattice. At 0.9% C, the split of the cubic lines into tetragonal doublets is already significant. The axial ratio increases with the C content. It is 1.034 for 0.97 C and 1.062 for 1.8% C. The change of the axial ratio with increasing cooling velocity is but slight. The lines of the cubic face-centered austenite can be observed from 0.6% C on. They become more pronounced with increasing C content and increasing cooling rate. The results of the structure analysis in connection with the thermal investigation, therefore, lead to the clear proof that point M corresponds to the appearance of a new tetragonal crystal. The opinion held formerly that the transformation is nothing other but a retarded pearlite transformation must be revised. The transformation M is practically independent of the cooling velocity, the transformation occurs very quickly with a pronounced heat effect. GN(10d)

Drawing (10e)

Drawing of Severely Quenched Alloy Steels. (Etude sur les revenues d'aciers speciaux hypertrempes.) ANDRE MICHEL & PIERRE BENAZET. *Revue de Metallurgie*, Vol. 27, Sept. 1930, pages 501–508.

When steels quenched from temperatures much higher than their critical points are drawn either a sudden very sharp dilatation corresponding to γ-α transformation of the metal or a gradual precipitation of the carbides subsequently followed by γ-α transformation can be observed. By heating under the transformation temperatures the steels belonging to the first class can be made to show gradual precipitation of the carbides. The present investigation was directed toward determination of the influence of alloy additions on behavior in drawing. Several C-Cr steels were investigated to determine temperature of complete austenization and the reactions on drawing. With 1.0 C and 6.0 Cr it is complete at 1250° C. and on drawing precipitation of carbides occurs at 530° C. and a violent transformation of γ into α at 580° C. Heating at 550° C. causes on cooling precipitation of carbides (gradual) and lowers γ-α transformation to about 150° C. With 16 Cr the transformation on straight heating is raised to 630° C. Using 0.6 C, 15 Cr one has to raise quenching temperature to 1250° C. while on cooling only a gradual precipitation of carbides can be obtained and no γ-α transformation. With the same C but 19 Cr precipitation of carbides is not completed after 17 hours at 600° C. but on cooling slight transformation takes place at 300° C. which is not present in the lower Cr steel. The carbides precipitated are not strictly double carbides but a product of replacement of Cr with Fe atoms. Presence of 5% W facilitates austenization of 5% Cr steel, but handicaps it with 10% Cr. In the first case heating to about 600° C. causes a sharp transformation to occur while γ-α change is lowered to about 100° C. With higher Cr heating at 680° C, precipitates carbides but no transformations take place on cooling. In Cr steels 10% Co appears to interfere with the austenization and helps in decomposition of austenite on drawing, but in amounts around 20% it has an opposite effect. JDG(10e)

Tempering of Mild Steels Containing Copper. *Metallurgist*, June 1930, pages 87–91.

A detailed review of the work of F. Nehl, *Stahl und Eisen*, Vol. 50, May 15, 1930, page 678 and of H. Buchholtz and W. Köster in *Stahl und Eisen*, Vol. 50, May 15, 1930, page 687. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 792 and 800 VVK(10e)

Heat Treatment of Soft Steel. (Il Trattamento termico dell'acciaio extradolce.) G. SIROVICH. *La Metallurgia Italiana*, Vol. 8, May 1930, pages 555–560.

The author states that the mechanical properties of mild steels as well as higher C steels depend on the drawing temperature, such as is used from 400–900° C. With increase in drawing temperature, elastic limit and tensile strength decrease while ductility gradually increases. This investigation, which was carried out at the Royal School of Engineering in Rome, Italy, shows that soft steel can be drawn and can exhibit special good properties after a proper heat treatment. Tables and diagrams are given showing the effect of drawing temperature on the mechanical properties. GTM(10e)

Aging (10f)

The Effect of Aging on the Behavior of Steels Subjected to Repeated Stresses. (Einfluss des Alterns auf das Verhalten weichen Stahles bei Schwingungsbeanspruchungen.) KARL ADERS. *Mitteilungen Forschungs-Institut Vereinigte Stahlwerke Aktiengesellschaft, Dortmund*, Vol. 1, No. 8 (1929) pages 201–221, 30 references.

Two steels having 0.07–0.08% C, 0.44–0.48% Mn, 0.01–0.05% Si, were tested and the results obtained showed that while the endurance is increased beyond the limit, the elastic limit is also increased. It was also noted that the whole structure exhibited a great number of gliding planes which were due to the repeated stresses. GTM(10f)

Age-Hardening. *Metallurgist*, June 1930, pages 81–82.

An historical discussion. VVK(10f)

On the Age-Hardening Mechanism in Al-Cu Alloys. S. KOKUBO *Kinzoku no Kenkyu*, July 1930, pages 343–370.

Al-Cu alloys containing 0 to 12% Cu were heated for 30 min. at 545° C and then quenched in water at 15° C. After aging for 10 to 20 days at room temperature, each of these specimens was heated for 6 hours at different temperatures up to 500°; they were then cooled slowly in furnace. Their density, electric resistance, hardness and thermal change were measured. The results do not agree with the conclusions of the precipitation theory of Merica and others. The results are represented in Fig. 1 in which the thermal change is shown in the electromotive force produced in the differential thermocouple. Density shows a minimum point at 270° C. Electric resistance begins to decrease abruptly at 150° C. Hardness shows a maximum at 170° C. The thermal change shows a minimum at 150° C., i. e., an absorption of heat; and a maximum at 260° and at 370° C., i. e., an evolution of heat. According to the precipitation theory, hardness increases with the precipitation of $CuAl_2$ and also with the increase in the size of $CuAl_2$ up to the critical size as shown in curve C; but this must be necessarily accompanied with heat evolution, in fact heat absorption is found. The author considers that in aging at 0–170° C. some copper atoms displace Al atoms in Al-space lattice; some Al atoms rotate by an angle 45° in the same plane; the Al-space lattice extends in the direction, [011] and contracts in the direction [011]. As the atomic volume of aluminum is larger than that of copper, there must occur great stresses in the space lattice of the metal. The results of these phenomena are the great increase in hardness, the absorption of heat and the small change of specific gravity and electric resistance. At the temperature 170–270° C. the precipitation of $CuAl_2$ takes place vividly and the result is the great evolution of heat and abrupt decrease of hardness, electric resistance and specific gravity. Above 270° C., the precipitated $CuAl_2$ gradually coagulates and forms its own space lattice. This means the decrease of potential energy and must be accompanied by heat evolution as shown in the figure (heat evolution at 370° C.). KT(10f)

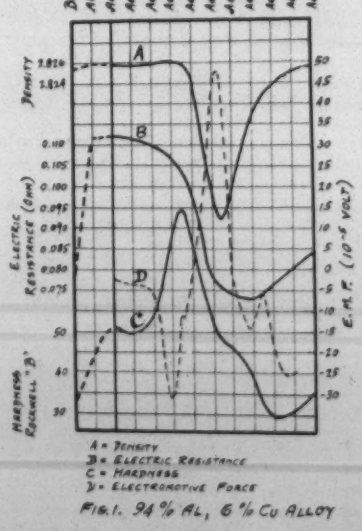

Fig. 1. 94% Al, 6% Cu Alloy

JOINING OF METALS & ALLOYS (11)

Brazing (11a)

Phosphor-Copper for Welding and Brazing. C. J. SNYDER. (Westinghouse Electric & Manufacturing Co.) *American Machinist*, Vol. 72, May 15, 1930, pages 793–795.

Phosphorus and copper make useful alloys when the phosphorous content is less than 15%. With an 8% phosphorous content, a eutectic of the compound Cu_3P and a solid solution of phosphorus is formed with a melting point of 707° C. This eutectic makes possible the use of these alloys for brazing. It is very fluid and has unusual welding, penetrating and flowing properties. Two alloys are suitable for practically all kinds of work, one contains from 6½% to 7½% of phosphorus and the other from 4½ to 5½%. The best temperature is from 750 to 825° C. Phosphorus being chemically active, reduces oxides on the surface of the metal and acts as a flux and cleaning agent. Because of the high temperatures necessary for brazing, the yield point of the parent metal adjacent to the joint will be approximately 4000, 12,000 and 18,000 lb./in.² for copper, brass and bronze respectively. A butt joint in copper bars brazed with phosphor-copper alloy will break between 18,000 and 32,000 lb./in.² Lap joints tested on a shear test will withstand from 12,000 to 19,000 lb./in.² depending on the material and method of brazing. RHP(11a)

Molybdenum-Wound Hydrogen Furnaces for Copper Brazing. C. M. THOMPSON. *Iron & Steel Engnieer*, Vol. 7, Sept. 1930, pages 471–473.

A square box-type furnace developed by the General Electric Co. has been constructed for the manufacture of Carboloy tipped circular saws. The heating chamber is 36″ × 6″ × 4″ with molybdenum wire heating elements mounted on each side and above the chamber 18″ long. The units are wound on alundum tile and are exposed. The hearth tile is of channel cross section, and vertical sliding door is at the front of the furnace. At the opposite end is a cooling chamber 24″ long, and between the heating and cooling chambers, there is an airtight gate valve protected from the high temperatures by a tile slide. Hydrogen is fed from the top and discharged through a peep hole in the charging door and a pilot under the discharge door of the cooling chamber. Hydrogen consumption is 10–12 ft.³/hour and the furnace will handle 25 lbs. of material/hour. WHB(11a)

Welding & Cutting (11c)

The New Rules for Rating and Testing of Arc-welding Machines for Direct Current. (Die neuen Regeln für die Bewertung und Prüfung von Lichtbogen Schweissmachinen für Gleichstrom, RESM/1931.) LOTTMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, June 21, 1930, pages 891–892.

Short review of the new rules agreed on by the Verband Deutscher Electrotechniker. Ha(11c)

Electric Welding. *Metallurgist*, Aug. 1930, pages 126–127.

A critical abstract of an article by K. Jurczyk in *Stahl und Eisen* of June 12, 1930. See *Metals & Alloys*, Vol.1, Nov. 1930, page 851. VVK(11c)

Developments in the Arc Welding of Mill Products. L. S. THURSTON. (General Electric Co.) *Rolling Mill Journal*, Vol. 4, Jan. 1930, pages 23–25.

Gives some outstanding examples of the application of electric arc welding to buildings, bridges, floors, pipe-lines and other structures fabricated from rolled sections and plates. MS(11c)

Most Favorable Currents in Arc-Welding. (Günstigste Stromstärken beim Lichtbogenschweissen.) H. JORDAN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, May 3, 1930, pages 580–581.

This article is a review of the results of the tests which were made by and described in the report of the Electric Arc Welding Committee of the American Welding Society. German tests also corroborate the experience that all welding methods give better results the quicker the welded seam is made, which means that in electric-welding high currents should be used. 5 bibliographical references. Ha(11c)

Welded Steel Floor Construction. LEE H. MILLER. (American Institute of Steel Construction, Inc.) *Welding Journal*, Vol. 27, June 1930, pages 169–171.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. AWM(11c)

The Effect of Contamination by Nitrogen on the Structure of Electric Welds. L. W. SCHUSTER. (British Engine, Boiler & Electrical Insurance Co.) *Iron & Steel Institute, Advance Copy* No. 8, Sept. 1930, 30 pages.

Contains bibliography of 50 references. Microscopic examination of arc welds made from various rods and in atmospheres of air, carbon dioxide, oxygen, nitrogen and hydrogen have shown that the needles found in welds are caused by nitrogen. Needles never occur in the absence of nitrogen. A heat treatment is frequently necessary to develop the needles. Typical photomicrographs are shown. JLG(11c)

Arc Welding in Industry. H. M. FRENCH. (General Electric Co.) *Mining & Metallurgy*, Vol. 11, July 1930, page 352.

Describes the various kinds of arc welding namely: Metallic arc, the carbon arc, atomic hydrogen arc and shielded arc methods. Gives advantages of arc welding structural steel building over riveting. Arc welded joints in pipe lines are favored. Atomic hydrogen arc successful on very thin stock. VSP(11c)

Recent Welded Bridges. (Neuere geschweisste Brücken.) R. BERNHARD. *Zetischrift Verein deutscher Ingenieure*, Vol. 74, Aug. 30, 1930, pages 1201–1207.

Three bridges built in 1929 are described. The principles of construction, static design and shop work, especially details deviating from usual practice, are described. It is emphasized that great care and attention must be paid to the tension due to welding and that the design has to be adapted to welded joints which differs from that of riveted joints. Under such conditions, bridges can be built more economically with the welding method. Ha(11c)

First Arc-Welded Pipe Line Goes into Republic of Mexico. *Iron Trade Review*, Vol. 86, Feb. 6, 1930, pages 84–85.

Describes construction of a natural gas pipe-line 165 miles long, running from Aquilares, Texas to Monterey, Mexico. It is of 12-inch pipe. MS(11c)

Testing Steel Sheet for Weldability. *American Machinist*, Vol. 72, May 15, 1930, page 790.

Impurities in steel affect weldability of steel. To test take a piece of sheet about 6 in. square and place flat on welding table. Use a tip on the oxyacetylene blow torch which is a size smaller than that prescribed on the welding chart. Light and adjust flame to neutral. Hold the blowpipe so that the tip of the inner cone of the flame is about one eighth inch from the sheet. Move the flame slowly in a straight line so that the sheet is melted without burning clear through. After a strip of about 3 in. in length is melted in this way the blow pipe is held still until a hole is burned through the sheet. The path followed by the blowpipe should be free from an excess of oxide or scale and be regular and smooth on the upper side. The under side will show a slight sag of smooth metal, free from oxide. The hole should be round and regular. RHP(11c)

Procedure Control in Welding. H. W. GILLETT. *Metals & Alloys*, Vol. 1, July 1930, page 612.

A note recommending attention to development of machine welding. A suggestion is made relative to the hazard of the personal equation. ESC(11c)

WORKING OF METALS & ALLOYS (12)

A Contribution to the Problem of Red-Shortness. (Ein Beitrag zur Frage des Rotbruchs.) A. NIEDENTHAL. *Krupp'sche Monatshefte*, Vol. 11, Aug. 1930, pages 209–220.

The article corresponds to the publication in *Archiv für Eisenhüttenwesen*, Vol. 3, August 1929, pages 79–97. Abstracted in *Metals & Alloys*, Vol. 1, April 1930, page 475. GN(12)

Melting & Refining (12a)

Open-Hearth Operators Discuss Their Steel Problems. *Iron Age*, Vol. 125, May 29, 1930, pages 1601–1604; June 5, 1930, pages 1669–1672; June 12, 1930, pages 1758–1760.

The eleventh annual meeting of the Open-Hearth Committee of the American Institute of Mining and Metallurgical Engineers held at Buffalo. VSP(12a)

Study of High-Manganese Slags in Relation to the Treatment of Low-Grade Manganiferous Ores. C. H. HERTY, JR., J. A. CONLEY & M. B. BOYER. *Report of Investigations* 3048, *United States Bureau of Mines*, Oct. 1930, 4 pages.

A tentative equilibrium diagram for the ternary system FeO-MnO-SiO_2 is proposed. The general shape of the liquids in the high manganese oxide corner is of a gradually descending slope from the melting point of pure manganese oxide down to the center of the diagram. The first break in the MnO–SiO_2 binary system occurs at or near the melting point of tephroite ($2MnO.SiO_2$). A boundary line extends from this point into the system and separates from the rest of the diagram the region of high manganese oxide in which manganese oxide doubtless exists as the solid phase in the liquid resulting from the decomposition of tephroite. This perhaps explains the high viscosity of the high manganese slags. Addition of 12 to 14% of alumina to such slags reduces the viscosity to a point where they can be handled. Tests showed that these high alumina slags can be reduced to ferro-manganese as satisfactorily as the low-alumina product. (Includes 4 footnote references.) AHE(12a)

Change of Volume of Iron during Melting. (Ueber die Volumenänderung des Eisens beim Schmelzen.) *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, July 12, 1930, page 969.

Short résumé of works of Honda and others. Ha(12a)

Refining Steel Ingots by the Miris Process. EDWARD D. LACY. *Metallurgia*, Vol. 2, Aug. 1930, pages 133–134.

The Miris process consists in a secret chemical treatment of the steel in ingot form. During the war it was used to make armor plate. Ordinary steel treated by this process has exceptional properties. JLG(12a)

Melting Bearing Bronze in Open-Flame Furnaces. ERNEST R. DARBY (Federal Mogul Corp.) *Metal Industry*, N. Y., Vol. 28, May, 1930, pages 214–215.

Paper read at the N. Y. meeting of the Institute of Metals Division, Feb., 1930. See *Metals & Alloys*, June 1930, page 586. VSP(12a)

Improvement in Copper Reverberatory Construction and Practice. A. H. RICHARDS. *Mining & Metallurgy*, Vol. 11, June 1930, pages 299–300.

Report of paper before the North Pacific Section, April 16, 1930. Outlines some of the fundamental factors which are responsible for the increased efficiency of modern reverberatory furnace. Furnace should be constructed to burn maximum amount of fuel in such a manner as to give the hottest flame that the refractory brick will stand. Contains a table giving the dimensions of reverberatory furnaces from 1800–1918. VSP(12a)

Molybdenum Steels. *Metallurgist*, July 1930, pages 110–111.

An account of the calcium molybdate method of introducing molybdenum into steel as given by Thomas Hardy in *Heat Treating & Forging* for April and May, 1930. VVK(12a)

Casting & Solidification (12b)

Alloy Steel Guns Cast Centrifugally with Mounts of Welded Parts. T. C. DICKSON. *Iron Age*, Vol. 125, May 22, 1930, pages 1521–1522.

Taken from a paper read before the Cleveland Engineering Society, May 13, 1930. The feature of centrifugal casting is that the C content of the inner bore is higher than the outside. Impurities collect on the inside and are easily removed. The next step is the hydraulic cold working treatment The advantages of this process are that more guns can be made in less time and at less cost. The gun carriages are made of welded structures. Mo-steel is used because it is the best alloy possible for severe requirements. The largest gun made by the centrifugal process weighed about 800 lb. VSP(12b)

Casting Railway Bronzes in Permanent Molds. HENRI MARIUS. (Lenoir Car Works.) *Metal Industry*, N. Y., Vol. 28, May 1930, pages 216–220.

Describes methods used and advantages over sand molding. See *Metals & Alloys*, June 1930, page 568. VSP(12b)

Designing Ingot Molds to Reduce Losses. EMIL GATHMANN. *Blast Furnace & Steel Plant*, Vol. 18, Jan., 1930, pages 119–121; *Iron Trade Review*, Vol. 86, Jan. 9, 1930, pages 25–27; *Rolling Mill Journal*, Vol. 3, Dec. 1929, pages 505–509.

Outlines factors which govern the design of ingot molds and discusses the cross-sections of various molds. Two, recently patented by the author, embody what he considers proper features for good surface in both big-end-up and big-end-down practice. The lines connecting the corners of the mold matrix are so corrugated as to offer no obstruction to free contraction of the metal toward the neutral lines of shrinkage. Corrugation of the secondary corners results in a flexible ingot surface. The corners are broad and are not apt to be burned in reheating or lapped in rolling. The projecting primary sides are spread in a direction approximately tangent with the axis of the rolls in the initial passes rather than flowed longitudinally, as is the case when the primary sides are wide and in substantially the same plane as the corners. The free, unworked adjacent sides are thus not elongated and are deformed only slightly. MS(12b)

Modern Zinc Base Die Casting. W. M. PIERCE. *Metals & Alloys*, Vol. 1, June 1930, pages 544–546.

Die casting requires an alloy which will not be contaminated by being retained in an iron pot in the molten state. High fluidity is needed for soundness and smooth finish. It must cast free from shrinkage strains. Zinc alloys containing 3–15% aluminum or 5–10% tin have been found satisfactory. Present practice utilizes a composition 1% aluminum, 3% copper, and frequently 0.1% magnesium. Less than 1% aluminum enters into solid solution with zinc to form an alloy known as the α-phase, zinc in aluminum up to 20% yields γ-phase alloy. Between 1–21% aluminum in zinc a eutectic of α-phase and β phase occurs with excess of α when aluminum content is less than 5% and excess of β when aluminum is above 5%. At 270° β is transformed to α and γ with increase in volume and evolution of heat. In pure zinc aluminum alloys the rapidity of this change causes stresses. Copper, magnesium and nickel aid materially in eliminating this factor. Early zinc alloys used for die casting showed inter-crystalline corrosion even before corrosion of surface grains. With copper containing alloys this factor may be almost completely eliminated. Heat treatment is useful in some cases. ESC(12b)

Rolling (12c)

Rolling of Aluminum Structural Shapes at the Massena Plant of the United States Aluminum Co. W. F. Boericke. *Mining & Metallurgy*, Vol. 11, April 1930, pages 222–223.

Discusses recent completion of a $4,000,000 addition to its plant, consisting of a larger blooming mill, and structural mill. Gives its organization, the distinction of possessing largest Al rolling mill in the world, as well as the first mill to roll Al exclusively. VSP(12c)

Tin and Sheet-Mill Rolls. Their Treatment, Performance and Premature Failure in Service. Eric R. Mort. *Engineer*, Vol. 149, May 16, 1930, pages 537–538; *Engineering*, Vol. 129, May 9, 1930, pages 615–617; *Foundry Trade Journal*, Vol, 42, May 22, 1930, pages 377–378, 387–388; *Iron & Coal Trades Review*, Vol, 120, May 2, 1930, pages 712–714.

Abstract of a paper before the British Iron & Steel Institute. See *Metals & Alloys*, Sept. 1930, page 737. VSP+RHP+LM(12c)

Sheet Steel and Blackplate Manufacture. John Mort. *Blast Furnace & Steel Plant*, Vol. 17, Dec. 1929, pages 1816–1822.

From a paper before the Swansea Technical College Metallurgical Society. Discusses design of bar and reheating furnaces. The basic factors are capacity, the temperature to which steel is to be raised and the fuel to be used. In addition, for reheating furnaces, the temperature at which the partly-rolled sheets are returned for reheating, and the sheet dimension must be considered. The rate of heating depends chiefly on the heat input and the design of the chamber. Chilled iron rolls are used. The principal factors which determine roll contour are: "Character of chill," roll dimensions; class of sheets to be rolled; temperature at which the rolls are to be maintained when in commission; method of contour control; and mill production. Uniformity of gage depends on uniform heating of bars and packs, roll contour and correct drafting. Discusses rather fully roll turning. Presents charts showing the fluctuations in roll temperature that occasionally take place under normal working conditions. MS(12c)

Investigations on the Production Capacity and Power Consumption in Rolling Different Steel Shapes. (Untersuchungen zur Feststellung der Leistungsfähigkeit und des Kraftverbrauches für verschiedene Walzprofile.) G. Bulle, C. N. Elsen & A. Knickenberg. *Stahl und Eisen*, Vol. 50, Aug. 7, 1930, pages 1121–1126, 4 references.

Report No. 76 of the Rolling Mill Committee of the Verein deutsche Eisenhüttenleute. Time and power consumption of various shapes were studied in 5 different rolling mills, namely a loop mill, a merchant mill for fine shapes, 2 bar mills and a rod mill to determine how the production cost changes with the dimensions of similar shapes and to find out the best economical conditions for running the mill. The power consumption for the actual deformation work in rolling (that means the values for power consumption when the mill is running light are deducted) is in simple relation to the shape size for rounds, flats, hoops, angles, tees and mining rails. The actual power consumption increases with decreasing diameter of rods and round bars and increasing thickness and width of flats, hoops, etc. The actual power consumption for hoops, flats and other small shapes is approximately the same, provided height of flange and thickness are the same. Capacity index cards are designed for power consumption and rolling time per ton of material rolled for the shapes investigated. By means of these capacity curves power consumption and production conditions for shapes never rolled before can be predetermined and different rolling mills can be compared as regards their efficiency. Investigations like this one open a field for improvement of production methods in rolling mills. GN(12c)

Sheet and Tinplate Rolls. An Investigation into the Roll Loads, Stresses and the Causes of Roll Breakage. J. Selwyn Caswell (University College, Swansea). *Proceedings South Wales Institute of Engineers*, Vol. 46, Aug. 22, 1930, pages 311–452; *Iron & Coal Trades Review*, Vol. 121, Aug. 15, 1930, pages 217-218.

After discussing the manufacture of sheet and tinplate rolls, the author presents data gathered over a year's time in 29 sheet and 28 tinplate mills on roll breakage, temperature variations in the mills, loads carried by sheet and tinplate rolls, torsional loads, physical properties of gray and chilled roll iron, the magnitude and variation of the stresses in the rolls [set up (1) in the foundry, (2) by the mill loads, (3) by thermal strains and (4) by other causes] and hair-cracks and firemarks on the faces of fracture. The ratio of number of rolls broken annually to number of mills is approximately 1.8 for tinplate and 4.0 for sheet mills. Average life of rolls is 16 weeks and 8 weeks for tinplate and sheet mill rolls, respectively. In tinplate mills life depends chiefly on the life of the chill in sheet mills on breakage. Greatest breakage is in winter. 82% broke through the body. Breakage is more frequent with large diameter rolls. Maximum loads in tinplate roughing mill = 500 tons, in finishing mill = 420 tons and in sheet mill = 1140 tons. Maximum torque is approximately 17,000 in.-tons. RPH+AHE(12c)

The Influence of the Lateral Pressure on Deformation during the Rolling Process and the Quality of the Material. (Der Einfluss des Seitendruckes auf die Formänderung beim Walzen und die Güte des Werkstoffs.) H. Hilterhaus. *Stahl und Eisen*, Vol. 50, Aug. 21, 1930, pages 1185–1194; Aug. 28, 1930, pages 1221–1229. Dr.-Ing. Thesis, Aachen, 1929.

After outlining the theories on the flow of material during rolling, the author submits the results of his investigations on a three-high mill. Results show that lateral pressure in the pass is practically vertical pressure. This opinion is proved by metallographic examinations and studies on the power consumption. Due to a decreased spread by vertical pressure, the upper section of the beams are not filled. Tests were carried out which explain the relations between underfilling and pressure, and the flange sections which receive no pressure during the process of deformation. Calculations check the practical results. GN(12c)

Strip Rolling Mills. W. W. Robertson. *Metallurgia*, Vol. 2, May 1930, pages 4–6.

General discussion of both hot and cold strip mills. Roller bearings can be used to advantage on hot mills and light type cold mills, but not with entire success on heavy type cold mills due to the necessary reduction in neck diameter. The new "flood" type bearing in which the oil is forced through the bearing under low pressure is successful. Maximum speeds of 300 feet per minute have been obtained with these bearings. Backed-up-type of mills are finding considerable application. Steel rolls are replacing chilled iron rolls. For hot rolling a not dead-hard steel is used and for cold rolling a chromium steel hardened to 100 Scleroscope is recommended. Backing rolls should be softer than the working rolls. The four-high mill has made possible the production of steel strip 36 inches wide. JLG(12c)

Forging (12d)

Construction of Drop Forging Dies. George A. Smart. *Heating Treating & Forging*, Vol. 15, July 1929, pages 841–842; Aug. 1929, pages 1004–1006; Sept. 1929, pages 1169–1171, 1175; Oct. 1929, pages 1293–1295; Nov. 1929, pages 1429–1432; Dec. 1929, pages 1564–1566; Vol. 16, Jan. 1930, pages 59–61, 63; Feb. 1930, pages 185–187; March 1930, pages 324–327; April 1930, pages 462–465; June 1930, pages 735–737, 742; Sept. 1930, pages 1147–1151; Oct. 1930, pages 1269–1272.

Parts XII–XIII are entitled "Dies for Bulldozing and Upsetting." Outlines general considerations in selecting the type of forging due to suit conditions in producing a given forging. Discusses layout of the die proper, blockers, fullers, rollers, cutoffs, dowells, snakers, locks, counter-locks, radii and fillets, templets, types, trimmers and punches, manufacture of miscellaneous forgings and forming and bending in bulldozers. MS(12d)

Shearing & Punching (12e)

Cutting and Punching of Metals. (Schneiden und Lochen von Metallen.) E. Siebel. *Stahl und Eisen*, Vol. 50, Aug. 14, 1930, pages 1172–1173.

E. Siebel reviews a paper by Ch. Frémont in Bulletin de la Société de l'-Encouragement pour l'Industrie Nationale, Vol. 128 (1929) pages 563–673, in which this author summarizes his ideas on cutting and punching. Frémont takes the standpoint that cutting and punching is not a pure shearing process, that the stresses are principally tensile stresses. To investigate the problem special methods were developed, which permit studying the deformation by observing the formation of gliding planes on polished samples. In cutting tests no relation could be established between tensile strength T and shear resistance C. For carbon steel, however, the relation $C = (T \times .35) + 6.5$ kg./mm.^{2} is correct. In punching tests with various steels the relation C:T = 0.71 to 0.75 was found. The influence of friction is relatively small for simple cutting; friction has a much heavier influence on the stamping process. Frémont furthermore shows how the punched section can be used for investigating the material. Metallographic static and dynamic bending tests are proposed. The author finally deals with the change of material and the effect of aging which takes place in the material around the punched holes. GN(12e)

Machining (12g)

Power Required to Drill Cast Iron and Steel. O. W. Boston & C. J. Oxford. *Transactions American Society Mechanical Engineers, Machine Shop Practice*, Vol. 52, Jan.-Apr. 1930, pages 5–26.

11 references. This paper presents the results of drilling tests on cast iron and steel. Drills ranging in diameter from $^1/_2$ to $1^1/_2$ in. of the standard twist-drill type were used. The drills were considered sharp in all tests. A coolant consisting of one part of soluble oil and 16 parts of water was used in all tests. The materials cut consisted of one regular machining cast iron and one cast iron made up of 20 percent charcoal pig iron, together with 17 steels of a wide variety of chemical analyses, which were selected to cover the steels commonly used in modern manufacture. Data as to drilling torque, thrust, computed horsepower at the drill point and net horsepower supplied to the machine as measured on a recording wattmeter are given under two headings: commercial tests and special tests. All commercial tests were run at a peripheral speed of the drill of approximately 60 ft. per min. The feed for each drill size was as near to those given in the usual commercial-drilling table as the change gears available would permit. Special tests were run on various cast irons and steels so that the influence of the speed feed, and drill diameter could be determined, in order that the results of the commercial-drilling tests could be extended to cover any other conditions of drilling for each material. It was found from these special tests that the thrust for both cast iron and steel increased in direct proportion to the drill diameter d; that the torque increased in proportion to d^2 for cast iron and $d^{1.8}$ for steel. The thrust increased with an increase in feed f, but at a rate as slow as $f^{0.6}$ for both cast iron and steel. The torque increased as $f^{0.6}$ for cast iron, but $f^{0.78}$ for steel. It was found that the torque and thrust remained practically constant over the whole range of speeds covered from 74 to 441 r. p. m. for each drill size and feed. An attempt made to correlate the hardness values of the materials determined by various hardness testers with the results obtained from the drilling tests showed that no satisfactory relation exists between these properties. (12g)

Test Code for High-Speed Steel for Turning Tools. *Advance Paper* No. 49, *American Society of Mechanical Engineers*, Dec. 2–6, 1929, 3 pages.

A report of Sub-Committee "D" on Properties of Materials of A. S. M. E. Special Research Committee on Cutting of Metals is given. An outline is given of the A. S. M. E. tentative test code for high-speed tool steel intended for the manufacture of lathe and planer tools; grinding; heat treatment; test forging; test cut; and work done by cutting tools. (12g)

Square Turning Alloy-Steel Ingots. *Metallurgia*, Vol. 2, June 1930, pages 65–66.

A lathe produced by H. A. Waldrich, Siegen, for removing the surface of a square ingot is described. Two or three tools can be used on each lathe at the same time. The square turning of ingots 44 inches long and 10 or 11 inches square takes only 40 to 48 minutes, including setting up and taking down. JLG(12g)

Tungsten Carbide Cutting Tools in America. *Metallurgist*, Vol. 5, Aug. 1929, pages 114–115.

The results are given of hardness tests of tungsten-carbide alloy with 6% cobalt and water-toughened manganese steel. (12g)

More Chips from Tungsten-Carbide Tools. Frank W. Curtis. *American Machinist*, Vol. 72, April 10, 1930, pages 608–611.

Tungsten-carbide tools should be ground as often as the tool steel previously used. To secure the proper service the speed and the feed should be increased. This often requires larger and heavier tools. Too wide or too long tips are to be avoided. The success of any metal cutting operation depends on rigidity so it is better to use a heavier tool than actually necessary. RHP(12g)

More Chips from Tungsten-Carbide Tools, Discussion. Chester B. Lord. (American Machinist.) *American Machinist*, Vol. 72, June 19, 1930, pages 985–986.

Discusses some parts of the article of the same title by Frank W. Curtis, *American Machinist*, Vol. 72, April 10, 1930, pages 608–611. There are many exceptions to the statement that the "ideal application is one in which the tool is ground as often as the steel tool previously used." Increase in machine size is not always economical and does not always produce the desired result. More information concerning cutting by tungsten-carbide is needed before some of the claims for it can be substantiated. RHP(12g)

Grinding Tungsten-Carbide Tools. *American Machinist*, Vol. 72, April 17, 1930, page 669.

Cemented tungsten-carbide can only be formed and finished by grinding, honing or lapping. Since it is costly only small amounts should be removed per grind. It should not be crowded against the grinding wheel. It may be ground either wet or dry. If dry, periodical cooling of the tool shank is necessary. It must not be quenched or the tip will check and crack. More rapid work is possible in wet grinding but for small jobs dry grinding is recommended. Either a diamond or a dresser, preferably the latter should be used in dressing. The diamond dresser tends to dull the abrasive, but is necessary if the wheel is to be formed. Roughing of tungsten-carbide tools should be done on a 60- or 80-grain wheel, finishing on a 100- to 120-grain wheel. Wheel speed of 4000 to 6000 is recommended. Illustrates methods of grinding special types of tools. Briefly discusses the lapping process and the cutting mixture used. RHP(12g)

Factors Affecting Machinability of Malleable Cast Iron. H. A. Schwartz. (National Malleable & Steel Castings Co.) *American Machinist*, Vol. 72, May 29, 1930, pages 871–873.

Data is given on a series of tests to determine the effect of carbon content on the machinability of malleable iron. The range of carbon content tested was from 2 to 3.10%. Tests used were drill, turning and threading tests. The data is not sufficient for very definite conclusions but indicate that carbon does affect machinability. The higher carbon is more easily machined. RHP(12g)

Drawing & Stamping (12h)

Application of Compressed Air Crimping Holders to the Working of Non-Ferrous Metals. (Verwendung von Druckluft-Faltenhaltern bei Verarbeitung von Nichteisenmetallen.) O. KÜHNER. *Zeitschrift für Metallkunde*, Vol. 22, June 1930, pages 190–193.

Paper deals with deep drawing of non-ferrous metals. Experience with commercial types of crimping or plate holders is given and a new device fully described which allows deep drawing of thin plates without rupture. By utilization of the maximum of drawing capacity intermediate annealing or some steps in the mechanical part of the drawing operation are rendered superfluous. The time required for placing the sheets into the machine is furthermore cut down. EF(12h)

Pickling (12i)

Treatment of Metals with Acids. (Die Behandlung der Metalle mit Säuren.) *Deutsche Goldschmiede-Zeitung*, Vol. 33, March 22, 1930, pages 136–137.

A general discussion of the use of acid solutions in metal working with particular reference to precious metals and their alloys. Discusses use in pickling, etching, coloring and dissolving JLG(12i)

Pickling Principles in Galvanizing. W. G. IMHOFF. *Iron Age*, Vol. 126, July 10, 1930, pages 82–83, 131.

Pickling time depends upon the temperature of the pickel. Varying the % of acid, operation may be speeded up or slowed down within wide limits. By controlling the temperature of pickling bath and installing standard conditions of pickling, direct saving of acid, steam, labor and time will result. "Acid brittleness" is of great importance in pickling wire. Proper pickling conditions should be a 4 to 5% acidity, temperature not over 170° F. and pickling time of 20 min. Gives views of practical men. VSP(12i)

The Pickling and Cleaning of Metals. I. Some Considerations of the Chemical Reactions Involved. DAVID BROWNLIE. *Sheet Metal Industries*, Vol. 4, Sept. 1930, pages 347–349.

The author discusses the acids used for pickling, namely, sulphuric, hydrochloric, hydrofluoric in rare cases, and nitric acid. The fundamental chemical equations involved are brought out. The effect of purity of the metal, purity of the acid, and the presence of moisture are considered. AWM(12i)

Cold Working (12j)

Texture of Cold Deformed Metals. (Texturen kaltverformter Metalle.) F. WEVER & W. E. SCHMID. *Zeitschrift für Metallkunde*, Vol. 22, April 1930, pages 133–140, 39 references.

A study was made to investigate the flow of metals and the resultant structure after cold deformation. A special device was applied by the authors allowing the metal to flow only in one direction perpendicular to the direction of compression. Parallelopipeds of Al—as a face centered cubic representative—and of Fe belonging to the group of body centered metals were compressed in various steps in the specially designed press and then studied for preferred orientation by means of X-rays according to the Debeye-Scherrer method. The laws of plastic deformation of cubic face centered single crystals are employed to interpret the resultant textures. The mechanism of plastic crystal warping is stressed. For the higher degrees of deformation pole-figures were obtained. The texture of Al submitted to parallellopiped deformation is established to be a superimposing of parts of the texture in case of axial-symmetric elongation or compression with the axes in the direction of flowing and compression respectively of the plane deformation process. The deviations of the experimentally determined atom planes from those derived from theoretical calculations are investigated in Al after various steps of deformation and are explained with the help of deformation and strain hardening processes observed in single crystals. The observations from the face centered cubic metal are converted to the body centered cubic arrangement under the presumption that the mechanism of deformation takes place along (011) as the gliding plane and in (111) as gliding direction. Since the parallelopiped deformation is closely related to the process of rolling as it is proved by the analogy of both textures, the authors arrive at a comprehensive representation of the most essential deformation textures based on the known deformation mechanism of single crystals. EF(12j)

Limit of Hardness for Certain Metals for Coins. *American Metal Market*, Vol. 37, Aug. 7, 1930, page 5.

The results of the experiments of three Frenchmen have been published by the Academie des Sciences, Paris. Experiments covered the limit of hardness obtainable with certain metals for making coins and medals by stamping. The compression obtained by cold treatment is the determining factor as regards hardness, and though the degree of hardness rises rapidly at the beginning of the compression, the limit appears to be obtained, with all metals and alloys investigated, when the thickness has been reduced by about 80% of the original dimension. With a reduction of about 76% nickel, and also a copper alloy with 8.8% aluminum showed the greatest degree of hardness. These were followed by a bronze with 94% copper, 4.6% tin and 1.4% zinc and by gold 90% pure. WHB(12j)

Preferred Orientation in Silver Foil Produced by Cold Rolling. CLEVELAND B. HOLLABAUGH. *Metals & Alloys*, Vol. 1, July 1930, pages 602–606.

According to earlier data, cold rolling of metals having a face centered cubic crystal structure causes one definite orientation, independent of the rolling technique. Aluminum and zinc show two possible orientations indicating a dependence upon the type of deformation. A study of the latter is conducted in this paper. Apparatus for X-ray patterns by the pinhole method and diffraction method were used. The sample was "fine" bar silver. Sample was annealed at 750°, 850°, 900° C. studying the orientation at intervals by both methods. The latter yields a completely random arrangement. A series of samples of various thicknesses were used. Two diffraction patterns were made of each. Technique of interpretation of patterns and data is completely explained. It is found that the mechanical working of silver produces two preferred orientations of crystals. The degree of preferment of each has been found. These preferred orientations are not affected by either the % reduction per pass nor the absolute reduction per pass through the rolls. ESC(12j)

Modern Practice in the Cold Rolling of Non-Ferrous Metals. C. E. DAVIES. *Metallurgia*, Vol. 2, Aug. 1930, pages 145–146.

Discusses methods and equipment used in rolling copper and its alloys. JLG(12j)

Cleaning (12k)

Metal De-greasing Plants with Tri-Chlor-Ethylene. (Metall-Entfettungsanlagen mit Trichloräthylen.) MAX HELLER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, July 26, 1930, pages 1069–1070.

For freeing large quantities of metal parts of oil, grease, etc., the non-inflammable and non-explosive tri-chlor-ethylene finds more and more use but it requires special equipment as the vapors are health-impairing. Several open and closed plants are described; the liquid can be recovered by distillation. Ha(12k)

DEFECTS (13)

Notes on Jackhammer Drill Steel. G. R. HEYWOOD. (Gen. Mgr., Rose Deep, Ltd.) *Mining Journal*, Vol. 169, June 28, 1930, pages 24–28.

Impact tests to destruction showed that (1) smoothness of bore was an important factor in the life of steel, (2) breakage was due to cracks starting from the bottom of minute corrosion pits in the bore of the steel (not to fatigue). Unforged shanks gave a marked increase in life. Failure of ¾-inch steel in the past has been due chiefly to breakage from heavy forging, not to inadequate cross section. Electric welding of broken steels prolonged their life but little. Various commercial brands are compared. AHE(13)

Failure of a Crankshaft. H. W. KEEBLE. *Metallurgia*, Vol. 2, May 1930, pages 35–36.

Gives results of a detailed examination of a crankshaft. The fracture was of the typical fatigue type. Microscopic examination indicates that the steel had been overheated and contained many inclusions. The shaft was poorly designed as there was an insufficient fillet at change of section. JLG(13)

Snow Flakes in Alloy Steel Forgings. H. H. ASHDOWN. *Iron Age*, Vol. 125, May 8, 1930, pages 1380–1381, 1429.

These defects usually lie beneath the surface of the forging and well removed from the ends. Presence of snow flakes is indicated by a type of hair line observed on longitudinal examination of finished machined forgings. All hair lines do not suggest the presence of snow flakes. Origin is in the ingot and mass action the ultimate cause. No form of heat treatment will correct it and the forgings are useless. Solid forgings may be re-worked to smaller sections. VSP(13)

Many Facts about Transverse Fissures yet to be Discovered. J. E. HOWARD. *Iron Age*, Vol. 125, May 22, 1930, page 1531.

Discusses the cause of an accident on Missouri Pacific Railroad. Summarizes the present status of transverse fissure problems. VSP(13)

Influence of Pores upon the Strength of Die Castings. (Der Einfluss von Poren auf die Festigkeit von Spritzguss.) L. FROMMER, W. KUNTZE & G. SACHS. *Zeitschrift Verein deutscher Ingenieure*, Vol. 73, Nov. 9, 1929, pages 2. 1609–1612; *Mitteilungen der deutschen Matrialprüfungsanstalten*, Vol. 13, 1930, pages 37–41.

Aluminum die castings were examined for porosity by means of X-rays and subjected to tensile tests. The tendency of breaking near the fillets was found to be the cause of greater variations in strength than the presence of pores. A number of specimens were cast in such a manner that they contained abnormally large pores. By suitable reduction of the specimen diameter fracture was obtained in the desired location. The pores were found to decrease the tensile strength in proportion to the decrease of actual cross section. No additional "notch" effect could be observed. These pores, which were much bigger than those commonly met with, caused variations within 10%, while the scatter limit of ordinary sound castings is 20%. X-ray examinations are recommended for the testing of die castings. Tensile specimens of the ordinary shape were found not to be suitable for establishing the influence of pores upon the strength of this material. Ha(13)

Crankshaft Fractures and Questions of Material. (Kurbelwellenbrüche und Werkstofffragen.) KURT MATTHAES. *Luftfahrtforschung*, Vol. 8, July 28, 1930, pages 91–120.

In operation of aeroplanes, fractures of crankshafts of six-cylinder engines have often occurred, the causes of which this paper attempts to explain. In a greater number of fractures which could be examined, the location of the fracture and its form was determined and conclusions drawn from it on the stresses which might have occurred. Chemical composition, structure and tensile properties, fatigue bending strength, torsional vibration strength, texture, defects of materials, and non-metallic inclusions were exactly examined. The frequency of fracture with age and the influence of refining on the life of a shaft are also considered. Suggestions are made for the prevention of such fractures. After all, it is stated that the question of crankshaft fractures is not a matter of material but rather of construction. Ha(13)

CHEMICAL ANALYSIS (14)

Application of Microscopic Analysis to Mixtures of Metals and Alloys. WILLET F. WHITMORE & FRANK SCHNEIDER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 173–176.

In order to employ microscopic qualitative analysis to the fullest extent in industrial work, a new system of separation of the metals has been developed. This eliminates the use of hydrogen sulphide, shortens the time of analysis, permits working with small amounts of material and dispenses with half the filtering operations required when the usual wet method of analysis is employed. 14 photomicrographs and 6 references are given. MEH(14)

Method for Determining Iron Oxide in Liquid Steel. *Foundry Trade Journal*, Vol. 42, April 24, 1930, page 313.

Brief discussion of method devised by the Metallurgical Section of Pittsburgh Experiment Station of the Bureau of Mines in coöperation with Carnegie Institute of Technology and the Metallurgical Advisory Board. It consists in killing a sample of liquid steel with excess of Al and determining the alumina formed. Killing is done with heavy Al wire in test spoon and not in mold. If killed in test mold, O may be lost at first moment of solidification or Al may segregate in the test piece. VSP(14)

The Quantitative Analysis of Steels by Spectrum Analysis. F. TWYMAN & A. A. FITCH; *Iron & Steel Industry & British Foundryman*, Vol. 4, Nov. 1930, pages 55–57; *Iron & Steel Institute, Advance Copy* No. 9, Sept. 1930, 12 pages.

7 references. A method for determining small amounts of common alloying elements in steels was developed. A logarithmic sector was used with a quartz spectrograph to form wedge spectra. The difference in length between a given iron wedge and a given wedge of the element to be analyzed was used in the analysis. The following elements can be determined with the accuracy indicated: Si up to 0.8%, accuracy 10% of content; Cr up to 4%, accuracy 5% of content; Ni up to 5% at least, accuracy 5% of content; Cu up to 1% at least, accuracy 5% of content. Methods for Mo and V can probably be developed. CHL+JLG(14)

Analytical Chemistry of Beryllium. (Beträge zur analytischen Chemie des Berylliums.) H. FISCHER. *Wissenschaftliche Veröffentlichungen des Siemens-Konzern*, Vol. 8, No. 1 (1929) pages 9–20.

Determination of Be in Cu, Ni or Zn alloys. 13 references. (14)

Terms of the Arc and Spark Spectra of Chromium. C. C. KIESS. *Bureau of Standards Journal of Research*, Vol. 5, Sept. 1930, pages 775–779.

Tables of terms are presented for the arc and first spark spectra of chromium. Babcock's unpublished Zeeman effects have aided in establishing many of them. Combinations of these terms account for nearly all the stronger lines of Cr I, and Cr II. All the terms which have been identified conform to the requirements of Hund's theory. (14)

The Determination of Chromium in Special Steels. (Die Bestimmung des Chroms in Sonderstählen.) P. KLINGER. *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 7–15; *Stahl und Eisen*, Vol. 50, Aug. 14, 1930, pages 1166–1167, 3 references.

Report No. 75 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. The known chemical methods on the determination of chromium in alloy steels were critically examined taking into consideration especially the influence of some alloying elements as for instance carbon, nickel, cobalt, vanadium, molybdenum and tungsten. Nine different methods were tested on 12 different steels. The permanganate-oxidation method in alkaline chloride solution with following oxidimetric or iodometric determination fails when Ni, Co, V, Mo and W are present. The elements have practically no influence on the other methods. The gravimetric chromium determination with mercurous nitrate cannot be applied for vanadium and tungsten steels without separating the elements. The permanganate-oxidation method cannot be used when larger amounts of nickel are present. This holds also for cobalt steels. The iodometric determination of chromium in vanadium steels can be used only in connection with the permanganate oxidation method in alkaline solution. The values obtained by other iodometric methods are too high. Copper, boron, aluminum, titanium, zirconium, tantalum and uranium have no influence on the determination of chromium. GN(14)

Determination of Oxides in Iron and Steel. (Beitrage zur Bestimmung der Oxyde in Eisen und Stahl.) F. MEISSNER. *Mitteilungen Forschungs-Institut Vereinigte Stahlwerke Aktiengesellschaft Dortmund*, Vol. 1, No. 9 (1930) pages 223–279, 90 references.

A general and critical review of all the methods for oxide determination in iron and steel such as chlorine, bromine, iodine, nitric acid, hydrogen reduction and microscopic examination. The Bromine and Iodine methods require a special treatment. By using the nitric acid method a great amount of residue is obtained, but also most of the oxides may be dissolved. An accurate determination of the oxides of manganese and iron is by the hot extraction with hydrogen, which reduces the oxides of iron at temperatures up to 1100° C. and the oxide of manganese at temperatures beyond 1000° C. When the carbon is high, the values obtained for the manganese and iron oxides are too low due to the reaction between the carbon and the oxides taking place at the temperatures of extraction. A new method developed only recently in Germany provides for this reaction between carbon and the oxides thus giving accurate values for the oxygen content in steel. GTM(14)

Streak Test for Platinum, Palladium and White Gold Alloys. (Strichprobe für Platin, Palladium und Weissgoldlegierungen.) HEINRICH MÜLLER. *Deutsche Goldschmiede-Zeitung*, Vol. 33, May 24, 1930, pages 4–5.

Describes rapid test for distinguishing between platinum, palladium and white gold. A streak of the material to be tested is treated with concentrated hydrochloric acid. If the streak is palladium it will turn a red brown, if a gold alloy the gold color will appear, and platinum as well as white gold made entirely of noble metals will not be attacked. If a drop of concentrated nitric is added to the drop of hydrochloric acid the cheaper white gold will dissolve, the platinum will be unattacked, and a white gold containing only noble metals will first turn green, then a gold color and will then be rapidly attacked. JLG(14)

Chemical Analysis of Refractories. (Die Chemische Untersuchung von feuerfesten Stoffen. III.) H. J. VAN ROYEN & H. GREWE. *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 17–21; *Stahl und Eisen*, Vol. 50, Aug. 28, 1930, pages 1229–1230.

Report 76 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. The investigation was undertaken to find a quick and reliable chemical determination of chrome-bricks since most of the present methods do not fulfill these requirements. GN(14)

Determination and Separation of Zirconium and Beryllium. (Bestimmung und Trennung von Zirkon und Beryllium.) OTTO RUFF & EDWARD STEPHAN. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 185, Dec. 10, 1929, pages 217–220.

The determination of Zr as ZrP_2O_7 usually gives results which are too high but if, after the fusion with $KHSO_4$ in a Pt crucible, the Pt is removed by precipitation with H_2S in acid solution, a correction factor is unnecessary. Zr can be separated from Be by precipitating the former as phosphate in dilute H_2SO_4 solution. Then by adding NH_4OH the Be is precipitated as phosphate. The ignited $Be_2P_2O_7$, however, weighs a little too much; so it is necessary to use a factor for converting the weight of precipitate into the corresponding weight of BeO. (14)

Measurement of Hydrogen-ion Concentration and Applications to Metallurgy. (L'Indicé d'Adidité ou p.H. Mesure et Applications en Métallurgie.) M. BALLAY. *Aciers Speciaux, Métaux et Alliages*, Vol. 4, July 1929, pages 319–321.

The author reviews the methods of measuring pH values and discusses the value of such measurements in connection with electrolytic deposits and with corrosion phenomena. (14)

Notes on the Determination of Molybdenum. H. A. DOERNER. *Information, Circular* 6335, *United States Bureau of Mines*, September 1930, 3 pages.

A brief description is given of the determination of molybdenum. The difficulties most likely to be encountered and methods for their elimination are noted. AHE(14)

Determination of Aluminum and Magnesium in Zinc-Base Die-Casting Alloys. CHARLES M. CRAIGHEAD. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 188–190.

Various methods applicable to the separation of aluminum and zinc in zinc-base die-casting alloys are discussed. The mercury cathode is suggested as a rapid and accurate method for the separation and determination of Al and Zn. A 2-gram sample of alloy is dissolved with 20 cc. of 1:1 sulphuric acid and 100 cc. of water. When all action has ceased, the solution containing the undissolved copper is transferred to the electrolytic beaker. The copper alloys with the mercury, 200 grams of which serves as the cathode in the beaker. The solution is electrolyzed for 5 hours, using a current strength of 1 ampere/6.25 cm.^{2}, and agitating the solution by compressed air. The solution is siphoned off, the beaker and electrode are washed 3 times before the circuit is broken, and the Hg (circuit broken) shaken with 25 cc. of water. To this solution 10 cc. of concentrated HCl are added and the Al is precipitated by the method of Blum (*Journal American Society*, Vol. 38 (1916) page 1282), by double precipitation. Mg is determined in the filtrate by a single precipitation as phosphate. 16 references cited. MEH(14)

Separation of Nickel and Cobalt by Means of Hypochlorite. F. H. RHODES & H. J. HOSKING. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 164–166.

Nickel and cobalt can be separated from each other by fractional precipitation with sodium hypochlorite, the sharpness of the separation may be increased by effecting the precipitation in hot solution, by allowing the precipitated oxide to stand in contact with the solution for a considerable time, and by adding sufficient alkali to neutralize the free acid formed by the interaction between the cobaltous salt and the hypochlorite. Under proper conditions it is possible to precipitate most of the cobalt free from nickel and to leave a final residual solution containing most of the nickel free from cobalt, with but a comparatively small intermediate fraction which contains both metals. MEH(14)

The Titration of Potassium Cyanide, and of Free Cyanide in Silver-Plating Solutions, by Means of Silver Nitrate. EDWARD B. SANIGAR. *Preprint* 58–5, *American Electrochemical Society*, Sept. 25–27, 1930, pages 49–68.

The effect of the presence of carbonate on the titration, by silver nitrate, of potassium cyanide solutions, and of the free cyanide present in silver-plating solutions, has been studied. The presence of carbonate has been shown to give rise to persistent precipitates during titration of the cyanide. The formation of these precipitates has been shown to be avoidable by the use of dilute solutions. Apart from these precipitates, carbonates were found not to interfere with these titrations. The removal of the carbonate by barium nitrate, barium chloride, calcium chloride or strontium nitrate was found to produce erroneous results, and to complicate the titrations by promoting precipitate formation. Additions of small amounts of N/10 sodium hydroxide were found to be without effect on the titration result, or on the formation of precipitates. Titration of the cyanide without using potassium iodide as indicator was found to yield slightly higher results. It was found that additions of ammonium hydroxide obviated precipitate formation, but that the concentration of ammonia had to be correlated carefully to the amount of potassium iodide used as indicator, if accurate results were to be obtained. (14)

The Determination of Silica in Ferrosilicon in the Presence of Silicon. (Die Bestimmung von Kieselsäure neben Silizium in Ferrosilizium.) A. STADELER. *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 1–6; *Stahl und Eisen*, Vol. 50, Aug. 7, 1930, pages 1132–1133, 11 references.

Report No. 74 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. The determinations were made by means of the chlorine method which is described in detail and which was developed due to the experience during the investigation. Ferrosilicons with 11%, 45% and 90% ferrosilicon were examined. Special tests were carried on on the possible loss of material during the process of chlorination, the best suitable temperature and the velocity of the chlorine gas. Uniform silica contents are found for temperatures between 500 and 600° C. whereas the values essentially decrease for temperatures between 625 and 650° C. The most suitable temperature is 500° C. A gas velocity of 10 liters per hour seems to be most suitable. The silica values fluctuate nevertheless and are 0.06–0.10% for the 11% ferrosilicon, 0.14–0.26% for the 45% ferrosilicon and 1.00–1.32% for the 90% ferrosilicon. Silica is probably present in ferrosilicon as impurity. The method of crushing ferrosilicon samples is of importance. Heating up in crushing must be avoided since the silica content depends upon the heating up of the sample. In crushing with an air hammer the silica content of 90% ferrosilicon samples increased from 0.37–0.62% after 10 minutes and to 1.09% after 30 minutes crushing. In crushing in an agate mortar practically no influence of the time of crushing was found. GN(14)

Volumetric Determination of Carbon in Difficultly Combustible Iron and Steel Alloys. (Zur volumetrischen Kohlenstoff-Bestimmung in schwer brennbaren Eisen- und Stahllegierungen.) E. ZINDEL. *Chemiker-Zeitung*, Vol. 53, Nov. 16, 1929, page 891.

As catalyst to be used instead of Bi_2O_3 it is often useful to mix some mild steel of known C content with samples which are otherwise difficult to burn. (14)

Quantitative Spectroscopic Analysis of Metals and Alloys. *Metallurgist*, Oct. 1929, pages 149–150.

Notes on the use of spectroscope in qualitative analysis; on attempts at quantitative work; and on the relative advantages in the use of arc and of spark sources. (14)

Determination of Chromium and Vanadium after Oxidation with Potassium Bromate. I. M. KOLTHOFF & ERNEST B. SANDELL. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 140–145.

The determination of chromium by addition of excess arsenious oxide to an acid chromate solution and back-titration with permanganate has been investigated systematically. Good results are obtained in the presence of vanadium, ferric iron and manganese at various acid concentrations. After chromium has been determined vanadate can be titrated in the same solution with ferrous sulphate, diphenylbenzidine being used as indicator. Oxidation of chromium and vanadium to chromate and vanadate, respectively, is effected by use of potassium bromate; the excess bromate is removed by boiling with ammonium sulphate. The method can be applied to the rapid determination of Cr and V in alloy steels. Tungsten interferes in the titration of V and must be removed. The time required for the total determination of Cr and V, including dissolving of the steel, is one hour or less, 11 references. MEH(14)

Titrometric Determination of Magnesium. J. STANTON PIERCE & M. B. GEIGER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 193–194.

In this work Mg is precipitated as the hydroxide with standard carbonate free alkali. When the endpoint for trinitrobenzene (a dark brick red) is obtained, the Ca remains in solution. The solution containing the precipitate is diluted to a definite volume, an aliquot part filtered and the excess alkali titrated. The accuracy of the method depends upon the completeness of precipitation of Mg, with Ca remaining in solution, and the endpoint when the excess alkali is titrated. The method which has been used with limestone analysis is given in detail. 9 references. MEH(14)

Confirmatory Test for Zinc. J. STANTON PIERCE & ETHYL D. NAVE. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, page 190.

The ferrocyande titration of zinc, with uranyl acetate as inside indicator can be used as a confirmatory test for zinc in qualitative analysis if interfering ions are first removed. MEH(14)

HISTORICAL & BIOGRAPHICAL (15)

Gold Metallurgy. A. K. ANDERSON. *Canadian Mining Journal*, Vol. 51, Oct. 10, 1930, pages 966–968, 971.

A review of developments during the past 50 years. WHB(15)

The Early Uses of the Metals. T. A. RICKARD. *Metal Industry* (London), Vol. 36, March 14, 1930, pages 301–302; March 21, pages 329–330; March 28, pages 359–360; April 4, pages 381–384; April 25, page 455.

Includes discussion. Condensed from a paper presented at the meeting of the Institute of Metals, March 12 and 13, 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 739. VSP(15)

The Metallography of Some Ancient Egyptian Implements. H. C. CARPENTER & J. M. ROBERTSON. *Engineer*, Vol. 149, May 16, 1930, page 538, *Engineering*, Vol. 129, May 16, 1930, page 641.

Abstract of paper before the British Iron & Steel Institute. See *Metals & Alloys*, Sept. 1930, page 739. LM(15)

Molybdenum in Special Steels. (Le Molybdene dans les aciers speciaux.) *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Jan. 1930, pages 27–32.

In a chronological order information is given about the researches carried out at the Creusot Works, France, where in 1894, Molybdenum Steel was for the first time produced, followed with Cr-Mo steel in 1895, Ni-Mo steel in 1895 and Ni-Cr-Mo steel in 1905. Most of these alloy steels were used in manufacture of munitions. GTM(15)

ECONOMIC (16)

Gold, Silver, Copper, Lead and Zinc in Washington in 1928. C. N. GERRY. *Mineral Resources of the United States*, 1928, part 1, Aug. 6, 1930, pages 689–703, *United States Bureau of Mines.*

The value of the mine production of gold, silver, copper, lead and zinc in Washington in 1928 ($633,156) was 26% less than in 1927 and much less than the average for the decade. Gold output decreased more than 16%, silver 36% in quantity, copper 30% in quantity and zinc more than 93%. Lead production increased 14%. AHE(16)

Gold, Silver, Copper, Lead, and Zinc in Idaho in 1928. C. N. GERRY. *Mineral Resources of the United States*, 1928, part 1, Aug. 6, 1930, pages 645–687, *United States Bureau of Mines.*

The value of mine production of gold, silver, copper, lead and zinc in Idaho decreased from $28,104,413 in 1927 to $26,667,706 in 1928, largely due to the large decline in lead production. The quantity of copper decreased 5%, but the value increased by the same amount. Gold output increased 37% over 1927. Silver production increased slightly. Lead decreased 4% in quantity and 11% in value! Zinc production increased 17%. AHE(16)

Mineral Resources of the United States, 1929. Preliminary Summary. FRANK J. KATZ & MARTHA B. CLARK. *United States Bureau of Mines*, July 1930, 120 pages.

The value of all mineral products in 1929 was $5,830,000,000, 8% more than 1928. The total value of the metallic products increased 15% and has been exceeded only in 1920 and 1923. Except for gold and silver all important metals contributed to this, copper accounting for nearly one-half. Smelter output of copper increased 10% in quantity and 34% in value. Production of copper outdistanced consumption. Steel production reached a new high level, exceeding 1928 by 9%. Shipments of pig iron also increased 8%. Production of high-grade manganese ore in 1929 showed the first increase since 1925. Mercury production was 1/3 greater than in 1928 and was the largest output since 1918. Gold production declined about 1%. AHE(16)

Cost of Using Welding. ROBT. E. KINKEAD (Consulting Engineer). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 19–22.

Points out difficulty of determining actual welding costs from figures obtained by using the cost indicator, labor, material and overhead. Stresses need of an additional cost indicator based upon the economic value of the product as obtained from life tests. LFM(16)

Gold Production and Its Future. H. A. KURSELL. *Booklet, American Smelting & Refining Co.*, April 9, 1930, 12 pages.

Gold production in various countries detailed. (16)

Engineering Markets of the World—IV. A. J. LIVERSEDGE. *Engineering*, Vol. 130, Sept. 5, 1930, pages 301–304.

Deals with trade situation in Australia giving tables of figures for following classes of engineering materials: metals and all manufactures of metals, iron and steel and manufactures thereof, machinery, vehicles and electrical apparatus. Regrets fact that United Kingdom is supplying only 1/3 of Australian imports of these materials while United States is supplying 1/2. Australia favors British Empire in matter of tariff. Merchant iron and steel, certain classes of wire, automobile parts, typewriters, etc., are admitted free from the United Kingdom. The curve showing imports of iron and steel from other sources than the United Kingdom shows decline since 1913. This is the only class showing such a decline. New Zealand buys more of these commodities per head than does Australia. Her tariff preference to the Empire is generous. Bolts and nuts, most classes of iron and steel, and some types of machinery are free to British manufacturers. There was a decline in engineering imports from the United Kingdom from 52.3% in 1928 to 47.6% in 1929. In the case of general iron and steel the British Empire seems to be doing as well as can be expected. Tables and graphs are given. LFM(16)

Production Cost for Welded and Cast Parts. (Gestehungskosten für geschweisste und gegossene Teile.) F. SIEBEL. *Elektrotechnische Zeitschrift*, Vol. 50, Feb. 27, 1930, page 339.

Two formulas for the production cost of welded and cast parts are developed which permit one to state clearly whether in a given case it would pay to make a pattern and cast the pieces or if it would be cheaper to weld the parts together from standard structural shapes. Ha(16)

Chinese Tungsten. *Chemical Engineering & Mining Review*, Vol. 22, July 5, 1930, pages 356–357.

Tungsten deposits are found in several northern provinces of China. China is credited with over 50% of the tungsten production of the world. WHB(16)

German Machine Tools in the World Markets. *Engineer*, Vol. 150, Aug. 15, 1930, page 177.

From article appearing in *Rhein-Westfulische Zeitung*. Official export statistics of Germany show that weight of exports of machine tools increased by 30% in the first half of 1930 and in value by 16% over corresponding period of 1929. Lists countries in order of their importance as purchasers of various types of machine tools. LFM(16)

Iron and Steel Industry for British Columbia. *Engineer*, Vol. 150, Aug. 22, 1930, pages 210–211.

Comments on reports concerning progress made in establishing a steel industry on the coast of British Columbia. The Freyn Engineering Company of Chicago is financing the scheme up to 23 million dollars. A 30 years' supply of iron ore is available as well as deposits of limestone and suitable coal for smelting purposes. Average iron ore content was found to be 61.7% from 16 drill holes. Ore is low in P, silica and alumina, has satisfactory Mn content and contains no Zn, As or Ti. LFM(16)

The Export Trade of France in Electric Furnace and Electrolytic Products. (La Commerce exterieure de la France en produits du four electrique et electrolyse en 1929.) *Journal du Four Electrique*, Vol. 39, Apr. 1930, pages 130–131.

A survey of French export trade in products made in electric furnaces and by electrolyis. JDG(16)

Norwegian Business in Electric Furnace Products. (Le commerce norvegien de produits du four electrique.) *Journal du Four Electrique*, Vol. 39, Mar. 1930, page 97.

A brief survey of Norwegian business in products made in electric furnaces. JDG(16)

Concrete Bar Trend is Westward; Large Jobs More Numerous. W. H. LLOYD. *Iron Trade Review*, Vol. 86, March 20, 1930, pages 45–47.

Survey of distribution in United States for last half of 1929. MS(16)

America's Surplus Scrap Supplies Europe and Orient. J. JOSEPH W. PALMER. *Iron Trade Review*, Vol. 86, Feb. 13, 1930, pages 49–50.

Over 500,000 gross tons of scrap was exported to 31 foreign markets in 1929. This tonnage was located too far from domestic melting centers to allow it to complete with other steelmaking materials, because of the freight charges. Cheap water transportation permits exportation to countries lacking material, such as Japan, Italy and Poland. MS(16)

Large Individual Awards Keep East in Structural Limelight. W. H. LLOYD. *Iron Trade Review*, Vol. 86, March 6, 1930, pages 81–84.

Survey of the distribution of structural steel in the United States for last half of 1929. MS(16)

PLANTS & LABORATORIES (17)

Fabricates Electrically Welded Steel Tubing in New Plant. A. H. ALLEN. *Iron Trade Review*, Vol. 85, Oct. 31, 1929, pages 1091–1093.

Steel & Tubes, Inc., has recently put into operation a new plant at Ferndale, Mich. Cold-rolled strip, 0.016–0.140 in. thick, is received in coils 150-400 ft. long. Material is a mild steel containing 0.08–0.12% C. These coils are rewound into coils 3000–3500 ft. long by special reeling machines. The strip is then fed to the electric welding machines which electrically butt weld the seam, cut the tubing off in standard mill lengths ranging from 12 ft. up, and eject it at the rate of about 60 ft. per min. There are six of these units, each of which has a capacity of 2000–2500 ft. per hr. They are equipped to make tubing 3/16–4 in. in diameter. After the tubing is formed and welded it is put through any required finishing processes. MS(17)

Modern Plant for Malleable Castings. *Iron Age*, Vol. 125, May 1, 1930, pages 1285–1289.

Describes plant of the United States Expansion Bolt Co. Annealing is done in tunnel kiln. Producer gas from hard coal is used. Air furnace fired alternately with oil and coal. Numerous illustrations. VSP(17)

Forging Practice Modernized by Mechanical Handling. C. B. PHILLIPS. (Surface Combustion Co.) *Iron Trade Review*, Vol. 86, March 6, 1930, pages 85–86, 92.

Describes equipment and practice of a plant for making rotary tool joints from alloy steel. Forging furnace is a continuous pusher-type, gas-fired billet heating furnace. It has preheating, heating and soaking zones, the parts being heated to 2300° F. The normalizing furnace is of the same general construction as the forging furnace. The highest temperature used in this furnace is 1650° F. MS (17)

Routing and Production System Affords Quick Shipment. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, Feb. 27, 1930, pages 55–58, 76.

Describes operations of the Allied Die Casting Corp., Long Island City, N. Y. MS(17)

Rolling of Large Aluminum Structural Shapes. *Rolling Mill Journal*, Vol. 4, March 1930, pages 89–93.

Description of the rolling mill of the United States Aluminum Co. at Massena, N. Y. MS(17)

Razor Parts Gold Plated at Rate of 100,000 a Day. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, Feb. 13, 1930, pages 51–53.

Describes operations of the American Safety Razor Co., Brooklyn, N. Y. Base metal used is brass. Pieces undergo thorough grinding, polishing, cleaning, rinsing and drying prior to plating. Pure gold anodes are used. Gold cyanide bath is freshened daily. Current is 60 amperes at about 3 1/2 volts. MS(17)

Stamping Plant Enjoys Steady Growth. A. H. ALLEN. *Iron Trade Review*, Vol. 86, March 27, 1930, pages 53–56, 71.

Deals with the Geometric Stamping Co., Cleveland. VSP(17)

Open-Hearth Furnace Steelworks. A Comparison of British and Continental Installations and Practice. H. C. WOOD. *Iron & Steel Institute, Advance Copy* No. 11, Sept. 1930, 32 pages.

Modern open-hearth design and layout is discussed, and various European plants are described in some detail. The author concludes that Continental steelworks furnaces are generally in advance of those in Great Britain. Best available mechanical equipment is universally employed. JLG(17)

Empire Platinum Refining in Great Britain. Acton Works to Be the Biggest in the World. *Mining Journal*, Vol. 169, June 28, 1930, pages 6–7.

The Acton refinery now has a minimum capacity of 300,000 ounces of platinum metals per year. The proportion of production of the various metals is roughly platinum 47%, palladium 39%, rhodium 4%, ruthenium 2%, iridium 1% and gold 7%. The average purity is platinum 99.93%, palladium 99.94%, rhodium 99.76%, ruthenium 99.72%, iridium 99.68%, gold 99.97% and silver 99.97%. The flow sheet is given. The chief feed at present comes from the Mond Nickel Refinery at Clydach and contains large amounts of silver and lead. Cupellation removes excess lead as litharge. Silver is dissolved in sulphuric acid. Aqua regia treatment of the residue gives a solution of platinum, palladium and gold. The platinum is precipitated as platinichloride, and the palladium as palladosamminechloride, which on ignition give sponge metals. Gold and silver are purified by electrolysis. The aqua regia insolubles contain the other rare metals. AHE(17)

Divers Heat-Treating Machines. FRED M. REITER. (Dayton Power & Light Co.). *Iron Age*, Vol. 125, May 15, 1930, pages 1449–1451.

Describes equipment installed by Dayton Forging & Heat Treating Co. Complete automatic control installed and full record maintained. Usable furnaces were reconditioned while obsolete equipment replaced. Natural gas replaces oil fuel, formerly used. Gives list of new equipment installed. VSP(17)

Replaces Fifty Year Old Furnace. *Iron Age*, Vol. 125, June 12, 1930, pages 1750–1751, 1795.

Wisconsin Steel Co. of South Chicago replaces an old hand filled blast furnace of 250 ton capacity with a new stack of 600 ton rating. Gives a description of the new furnace. VSP(17)

A New Engineering Laboratory. F. V. LARKIN & S. S. SEYFERT. *Mechanical Engineering*, Vol. 52, Oct. 1930, pages 883–887.

A description of the James Ward Packard Laboratory of electrical and mechanical engineering at Lehigh University, and of the principles involved in its design and construction and operation, GN(17)

Aluminum Research Program Extended. *Automotive Industries*, Vol. 63, July 5, 1930, pages 13–14.

The new laboratories of the Aluminum Company of America at New Kensington, Pa. are briefly described. GN(17)

Scientific Control in the Production of Bronze Castings. *Brass World*, Vol. 26, Sept. 1930, pages 233–236.

A glimpse of the new foundry of the National Bronze Co. Ltd. in Montreal. This foundry started operation early in 1930 and is now turning out 30,000 lbs. of castings per day. Both electric arc and gas-fired crucible furnaces are employed. A completely equipped control laboratory has been provided. WHB(17)

Modern Foundry Layout. *Metallurgia*, Vol. 2, July 1930, pages 77–80 and 83.

Describes the foundry at Morris Motors Ltd., which was designed to produce castings for 1000 motors weekly. The building has 7 bays, each 25 feet wide. It contains 3 Pneulec cupolas, each 3 1/2 feet in diameter at the melting zone. JLG(17)

Drawn Stampings of Rustless Steel. *Iron Age*, Vol. 125, June 12, 1930, pages 1755–1757.

Describes the production of rustless hub, radiator and gas tank caps by the Eaton Axle and Spring Co., Cleveland. It has a capacity of 1,000,000 caps and the same number of necks and flanges. Steels used are a high Cr-Ni containing 18% Cr and 8% Ni, and the other an 18% Cr and no Ni. Plain Cr steel is suitable for caps requiring only slight draw. Cold rolled steel, mostly 0.025 in. gage, is used for caps. The deepest drawing required of any part is 1 1/8 inch on the lower section of radiator caps. Radiator necks are made of strip brass. Plain C steel caps are plated. The usual sequence of operation is Cu plating, Ni plating, Ni buffing, Cr plating and Cr buffing. VSP(17)

FOUNDRY PRACTICE & APPLIANCES (22)

Essential Properties of Molding Sands. A. H. Dierker. *The Steel Founder*, Vol. 1, May 1930, page 16.
Short discussion. MLM(22)

Preliminary Studies of the Effect of Deoxidation and Mold Conditions on the Tensile Properties of Carbon Steel Castings. J. V. McCrae & R. L. Dowdell. *Bureau of Standards Journal of Research*, Vol. 5, Aug. 1930, pages 265–277.
Foundrymen occasionally experience difficulties with steel castings in meeting ductility specifications of 24% elongation and 35% reduction of area if the steel is deoxidized with aluminum shortly before pouring the castings. Sound castings can usually be obtained in dry sand molds without the addition of "deoxidizers" immediately before pouring. Green sand molding is generally desired but porosity, as "pinholes," often occurs. Aluminum and other "deoxidizers" studied eliminated porosity but lowered the ductility. The mold conditions are probably the important variables responsible for pinholes. A sufficient amount of "deoxidizer," however, should be in the steel at the time of pouring to deoxidize the steel from the gases evolved from the moisture contained in the mold. (22)

Steel Foundry Complexities. Frederick A. Melmoth. *Canadian Chemistry & Metallurgy*, Vol. 14, Aug. 1930, pages 240–242, 244, 246.
Steel foundry complexities may be grouped as: (1) metallurgical, (2) mechanical, (3) administrative. Melmoth considers chiefly the first group. (22)

The Detroit Rocking Electric Furnace as Applied to the Production of High Test Gray Iron. Carl H. Morken. *Preprint* 58–17, *American Electrochemical Society*, Sept. 25–27, 1930, pages 229–240.
Utilization of the electric furnace has enabled the small as well as the large foundry to produce high test gray iron. The Detroit rocking electric furnace is described, and it is shown how this furnace is used for smelting and processing gray iron. Operating data and costs are given with the properties of the iron. The rocking action of this furnace has a marked effect upon the properties of the iron. With this furnace, high test gray iron can be produced at costs below those of cupola iron. (22)

Progressive Foundries Secure Work in Lean Times. *Metallurgia*, Vol. 2, July 1930, pages 94–96.
Foundries that have shown real advancement in development and in installation of modern equipment are kept busy, while others are idle. Describes several well ordered foundries. JLG(22)

Some Notes on Foundry Equipment and Appliances. *Metallurgia*, Vol. 2, July 1930, pages 109–112.
Describes sand testing equipment, mixing machines, ovens, melting furnaces and cleaning equipment. JLG(22)

Production of High Test Cast Iron. G. Neuendorff. *Metals & Alloys*, Vol. 1, July 1930, pages 620–625.
A correlated abstract. Keep observed in 1898 that low silicon cast iron is less sensible to the cooling rate than high silicon iron due to decreasing graphite crystallization with decreasing silicon content. In 1906 Goerens indicated that cast iron to yield its best properties should be in a pearlitic condition. The Diefenthäler patent yields Lanz pearlitic iron. It is obtained by carefully selecting composition varying with the cross section of the casting and heating the sand molds, to obtain a suitable cooling rate. Bauer reported data on structure and physical properties. The pronounced resistance to abrasion and high stability of volume of pearlitic cast iron are highly useful properties. Coincidently considerable attention was diverted to the desirable properties resulting from finely divided graphite crystals. Sipp, Bauer and Maurer commented on this. Bardenheuer and Zeyen indicate that if coarse graphite crystallization is avoided, improvements in physical properties can be obtained by influencing the ground mass. Wüst and Leyde pointed out the desirability of kind and size of graphite rather than the quantity of it. Wüst and Kettenbach found that bending strength tensile strength and hardness generally decrease with increasing carbon content. Emmel developed the cupola process suitable for manufacture of 3% carbon high test cast iron. Krupp "Sternguss" and the Ross Mechan "Mechanite" are similar products. The Corsalli process for manufacture of low carbon cast iron is also satisfactory. Shüz obtained the graphite eutectic with 3% silicon and subsequent heat treatment. Piwowarsky and Northcott indicate an increase in graphite with higher casting temperature whereas Hailstone, Murakami and Honda observed the converse. Hanemann pointed out the need for consideration of the velocity of solution of the graphite nuclei in the melt. He explains Piwowarsky's reversal. This resulted in a practical procedure; viz., super-heating at a lower temperature for a longer period. Bardenheuer and Zeyen observed that the physical properties depended largely on the carbon content. These data are included. Low carbon melts show a decrease in physical properties, whereas melts with high carbon content show an essential improvement which is due to a fine graphite crystallization. The Wüst furnace for superheating is a combination of cupola and oil-fired furnace. The Deschesne method using a cupola forehearth which is lifted by means of 2 trunnions about 100 times a minute. Various observations throw doubt on this method. The electric furnace is highly satisfactory. Kerpely produced high test cast iron even with high phosphorous content. The Brackelsberg furnace permits rapid melting, and consequent reduction of oxidation; the slag layer of the metal bath prevents saturation with gases and oxides. This results in a cast iron with a dense structure free from cavities, holes and pipes. The molten metal has a high fluidity. The furnace is of abnormally high thermal efficiency. Hatfield, Piwowarsky and Smalley observe slight beneficial effects from alloying cast iron. Data regarding the effect of a variety of constituents are included. Correction see *Metals & Alloys*, Vol. 1, Sept. 1930, page 702. ESC(22)

Some Technical Aspects of the Electric Steel Foundry. D. K. Barclay. *Foundry Trade Journal*, Vol. 42, April 10, 1930, pages 269–271, 276.
Paper read before Middlesborough section of the Institute of British Foundrymen. Concerned with a 7-ton Herault type furnace worked with a basic hearth. Describes steel making process. Reactions taking place are as follows: The carbon combines with iron oxide forming carbon monoxide and iron; manganese and silicon are oxidized to manganous oxide and silica. Elimination of phosphorus proceeds, in combination with iron oxide the pentoxide is formed, which in turn combines with lime to form calcium phosphate. A typical dephosphorizing slag by partial oxidization method is as follows: SiO_2 16.26; FeO 8.41; Al_2O_3 2.84; MnO, 4.37; CaO, 53.23; MgO 13.78; and P_2O_5, 9.82%. Hot pouring allows solid non-metallic inclusions and gases to rise to the top, but it favors segregation, cracking, excessive shrinkage, burning-on and very often is responsible for ingotism. Cold pouring means quick solidification with less risk of cracking but does not always give sharp impressions of the mold, also short runs and overlaps. Describes molding sands to be used. Other topics taken up are drying of cores and heat treatment of castings. VSP(22)

Monel Metal Castings. Fred M. Chambers. *Metals & Alloys*, Vol. 1, July 1930, page 619.
Technique for manufacture of a variety of good Monel castings is described. ESC(22)

Power for Moulding Machines. A. S. Beech. *Metallurgia*, Vol. 2, Sept. 1930, pages 172, 188.
The author discusses the merits and demerits of the various motive powers employed in the foundry. GTM(22)

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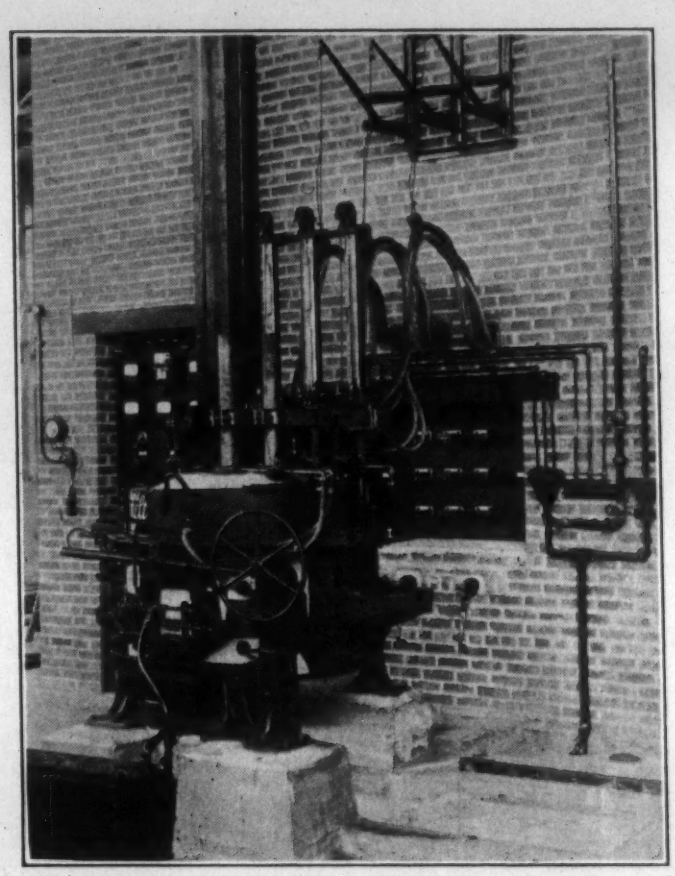

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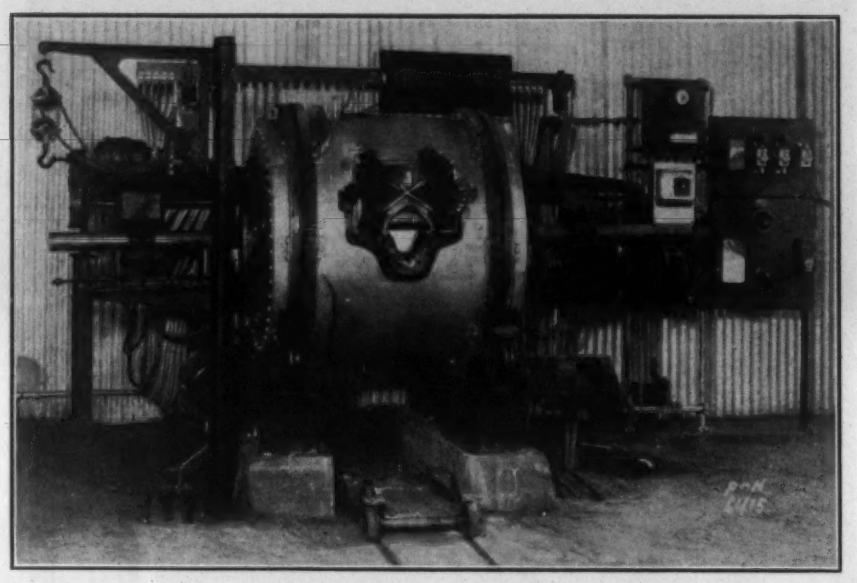

Typical view 1000/2000 lb. furnace

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FURNACES & FUELS (23)

Fuel Oil for Industrial Furnaces. L. D. Becker. *Advance Paper, American Society of Mechanical Engineers*, Oct. 7–10, 1929, 5 pages.

Describes improved designs in furnaces that have resulted in oil-fuel economy. Types of furnaces in which oil is used as fuel are cited and the advantages of oil as a fuel explained. (23)

New Methods for Chemical Utilization of Coal. (Les nouvelles methodes d'utilization chimique du charbon.) Ch. Berthelot. *Revue de Metallurgie*, Vol. 27, 1930, pages 381–391.

A sketch of the present tendencies for utilization of coal including catalytic preparation of organic compounds and liquefication of coal. JDG(23)

The New Open Hearth Furnace "Terni." (Les Nouveaux fours Martin à grande production de la Societe "Terni.") G. B. Bruno. *Aciers Speciaux, Métaux & Alliages*, Vol. 5, March 1930, pages 99–106.

The new open-hearth furnace "Terni" is a revolution in metallurgical industry through its performances and characteristics. A new trend to produce a more intense combustion is shown in the Moll and Lackner open-hearth furnaces, but "Terni" furnace surpasses them. The first "Terni" furnace was put into operation in 1926, producing any kind of steel. From experiments carried on during two weeks, this furnace produced about 8.2 tons per hour, in average charges of 50 tons. The principal characteristics of this furnace are: (1) A special combustion chamber, preheated gas and air are intimately mixed and this mixture is further diluted in the furnace with new supply of air. (2) Means to vary the velocity of the flame. (3) Means to control the quantity and type of the flame and combustion, different than the ones already in use in the open-hearth. (4) High temperature of recuperation for air and gas, at 1350° C. (5) Long run of furnace with less necessary repairs. (6) No complications of the water cooling system. (7) Facility to make any type of high quality steel in this furnace. GTM(23)

High-Frequency Steel Furnaces. D. F. Campbell. *Iron & Steel Institute, Advance Copy* No. 1, Sept. 1930, 10 pages; *Iron & Coal Trades Review*, Vol. 121, Sept. 26, 1930, pages 458–459; *Engineering*, Vol. 130, Sept. 26, 1930, pages 409–411.

Ironless induction furnaces melting 25 cwt. of steel have been used, and furnaces that would melt up to 5 tons could be designed. The high frequency furnace has been used in melting tool steels, low carbon alloys, various heat-resistant alloys, and in melting rolling mill scrap. It has not been often used as a refining furnace, but the refining action is rapid and it might be used in place of the open-hearth. In comparison to the open-hearth the heat is more efficiently used, and the investment is much less. The high frequency furnace is suitable for making all grades of high and medium quality steel, except where very large castings are required. Time and power records are given for several furnaces melting various steels. LFM+JLG(23)

Some Further Notes on Gas and Air Blast Apparatus. H. R. Hems. *Gas World*, Vol. 91 (Supplement), Sept. 21, 1929, pages 11–15.

Treats the following subjects: (1) direct fired furnaces, (2) surface combustion type oven furnace, (3) recuperative furnaces, (4) recent design of oven furnace, (5) regenerative types, (6) method of operation, (7) high speed steel furnaces, (8) forging furnaces. (23)

Electric Furnace Transformers. (Les Transformateurs pour Fours Electriques.) G. Marty. *Aciers Speciaux, Métaux et Alliages*, Aug. 1930, Vol. 5, pages 360–370.

After giving a short description of the particular advantages of electric furnaces indicating special qualities of the transformers, the author describes the characteristics of the transformer especially built to carry 100,000 amperes. GTM(23)

The Use of Gas in the Preparation of Non-Ferrous Metals. (Ueber die Verwendung des Gases zur Verarbeitung der Nichteisenmetalle.) M. Meier. *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 521–525.

Describes the processes and gas furnaces and apparatus used in the preparation and working of non-ferrous metals, such as Cu melting, Cu drawing, tinning of Cu wire, melting of type metals, bearing metals and die castings, melting Ag and Au, Ag and Au soldering, heat treating Al alloys. Details of construction, including illustrations, advantages over other methods of heating, ease of control and comparative costs are discussed. CEM(23)

Heating Up of Small Industrial Furnaces with Coke Oven Gas. (Das Anheizen kleiner Industrieöfen mit Koksofengas.) H. Repky. *Stahl und Eisen*, Vol. 50, Sept. 4, 1930, pages 1270–1272.

Two essentially different types of furnace were examined: furnaces with direct heating, that means the burners are directly inserted in the furnace; and furnaces with indirect heating, which means the burners are inserted in a combustion chamber underneath the hearth of the furnace. Time-temperature heating diagrams are presented and discussed for furnaces of various capacities. GN(23)

The Coreless Induction Furnace. A. G. Robiette. *Metallurgia*, Vol. 2, July 1930, pages 105–108.

The original Ajax-Northrup furnace supplied with high frequency current by a spark gap was satisfactory for small furnaces, but is not suitable for large furnaces. The large furnaces can be operated economically at frequencies that can be obtained from a generator. A 5 cwt. furnace operates well with a 2200 cycle current and a one ton furnace can be operated with 1000 or less cycle current. The furnaces make a highly inductive load, with a very low power factor, which can be compensated with condensers. In the larger units it is possible to switch in or out part of the condensers and keep the power factor at unity. Linings are now frittered in by heating a metallic template embedded in the loose refractory that is to be the lining. The template may be the first charge. An average life of about 60 heats has been obtained with these linings. The motion produced in the metal by the current is an aid to refining. Contains 2 references. JLG(23)

The Penetration of Heat into the Charge During the Annealing of Brass Plates. (Das Eindringen der Wärme in die Glühhaufen beim Ausglühen von Messingblechen.) W. Roth. *Zeitschrift für Metallkunde*, Vol. 21, Dec. 1929, pages 414–415; *Metal Industry* (London), Vol. 36, April 11, 1930, pages 403–404.

A study was made to investigate the penetration and distribution of heat in brass plates of 3,000, 1 000 and 120 kg. in annealing furnaces under varying conditions. The temperature during annealing of several hours was closely followed by means of numerous thermocouples and the most economic use of the furnace derived from the heating curves, showing that a more uniform heating is obtained with smaller charges or with divided charges. Pressing plates tightly together results in a more rapid and uniform heating. Electrical heating is recommended. VSP+EF(23)

Three-Phase Arc Furnaces. (Der Drehstrom-Lichtbogenofen.) Siegmund Schey. *Giesserei Zeitung*, Vol. 26, Oct. 15, 1929, pages 583–587.

Different parts of the equipment of electric steel furnace are described. On the basis of this, aspects for correct design are discussed. Details are given of reactance choking coils, electrode regulation and high-voltage switch-gear. (23)

Making One's Own Electric Resistance Furnaces. (Die Eigenherstellung von elektrischen Widerstandsöfen.) Erich Schwarz-Bergkampf. *Chemische Fabrik*, Vol. 2, Dec. 11, 1929, pages 519–520.

Directions are given for constructing Cr-Ni wire furnaces for temperatures up to 1000° C., and for changing the connections of the Siemens-Müller 110 volt furnace for other voltages. (23)

Scientific Foundations of the Thermal Features of Industrial Furnaces. (Les bases scientifiques thermiques des fours industriels) G. Zotos. *Revue de Metallurgie*, Vol. 27, July 1930, pages 352–361.

Theoretical discussion of the factors involved in furnace design. JDG(23)

Melting Furnace Fired by Coke or Oil. *Brass World*, Vol. 26, July 1930, page 185.

The Monarch Engineering & Manufacturing Co., Baltimore, Md. has placed on the market a metal melting furnace that can be changed over to use either gas or oil or coke, coal or wood for fuel. It can be changed over for use with an oil or gas burner when such equipment becomes available or desirable. Coke can be used in combination with oil to produce high efficiency and save time. If oil or gas are to be employed regularly the grate bars at the bottom may be bricked over and a pot of 275 lbs. capacity installed to replace the 150-lb. pot used with the combination arrangement. The furnace is claimed to be good for melting red or yellow brass, copper, bronze, aluminum, iron, etc. WHB(23)

Electric Nitriding Furnace. *Canadian Chemistry & Metallurgy*, Vol. 14, Aug. 1930, page 246.

The Canadian General Electric Co. Ltd. has developed a line of nitriding furnaces of the box type with swinging door, an inner retort, and a charging truck for handling the retort. Temperature control is automatic and cast iron rollers are provided in the floor of the furnace for convenience in handling the charge retort. A charging truck has rollers. The furnace is available in several sizes. WHB(23)

Cracking Device Makes Substitute for Hydrogen. *Electrical World*, Vol. 96, July 26, 1930, page 194.

"Electrolene" is produced by feeding steam and gas, or other hydrocarbons, into an electric cracking device developed by the General Electric Co. The heat necessary for the cracking is generated by electricity. "Electrolene" can be produced at about one-tenth the cost of hydrogen and consists principally of hydrogen and carbon monoxide. It is valuable for use in electric furnaces with controllable atmospheres, in heat treatment work, brazing, etc. WHB(23)

Armas System of Automatic Electrode Control. (La regulation automatique des electrodes systeme Armas.) *Journal du Four Electrique*, Vol. 39, May 1930, pages 179–189.

A description of hydro-electric electrode regulator in which the inertia of the moving part is reduced to a minimum. JDG(23)

Pulverized-Fuel Firing for Metallurgical Work. *Metallurgia*, Vol. 2, June 1930, pages 41–44.

The advantages of using pulverized coal in metallurgical processes are stressed. Pulverized fuel can be used economically in puddled-iron furnaces, annealing furnaces, billet-heating furnaces and in furnaces producing malleable iron. Heating with this fuel is rapid and can be readily controlled. JLG(23)

Small Induction Furnaces for Laboratories. *Metallurgia*, Vol. 2, June 1930, pages 68–69.

Describes a small high frequency furnace developed by the Metropolitan-Vickers Electrical Co. An oscillator valve is used to produce frequencies up to 500,000 cycles. Charges up to ½ lb. can be melted in 2 to 3 minutes. A normal charge of 5 lbs. requires 20 – 30 minutes. JLG(23)

Economic Annealing Ovens. *Metallurgia*, Vol. 2, July 1930, page 84.

Regeneration applied to gas furnaces decreases gas consumption. Data on the gas required in annealing cast iron in a "Revergen" furnace made by Qualcast, Ltd. are given. With this furnace at 1000° C. the flue gases contain about 45% of the heat generated, but at the outlet of the regenerator they contain only about 5%. JLG(23)

Form of Furnace for Heat Treatment. Robert M. Keeney. *Metals & Alloys*, Vol. 1, July 1930, pages 589–594.

Uniformity of chamber temperature in a heat treating furnace depends upon the design of the furnace and method of heat utilization whatever the source of heat. Less skill is required to design a furnace offering relative uniformity of chamber temperature where electricity is used rather than other sources of heat. In poorly designed box type furnaces there may be a variation of 200° F. whereas the average will show variations of 35–60° F. when operating at 1500–1600° F. Direct firing should be used below 1900° and must be used above that temperature. Under-fired furnace yields greatest uniformity. The height of furnace is a much more difficult factor in temperature control than is the width. Relative uniformity of temperature in the electric furnace depends upon the arrangement of the heating elements, the uniformity of insulation of the furnace, elimination of excessive loss of heat at spots in the furnace by "through metal loss," that is, loss of heat through conduction of heat by parts of the furnace structure which may project into the chamber, and elimination of an excessive door loss. Uniformity is affected by improper loading. Care should be exercised to select a suitable type of furnace, for example tubing can be more satisfactorily annealed in a continuous furnace than a batch type furnace. A form of furnace and method of heat application suitable for high temperatures may not produce a uniformly heated product in a low temperature process as in tempering. Discussion is offered regarding the effect of furnace design, on rate of heating, time of exposure, temperature control and atmosphere of furnace. Data are presented regarding the effect upon over-all costs. ESC(23)

Studies on the New Furnace "Terni." (Gli studi che hanno condotoo alla realizzazione del Forno "Terni".) F. Fiorelli. *La Metallurgia Italiana*, Vol. 8, Aug. 1930, pages 770–773.

Discusses general characteristics of an open-hearth furnace especially the usual combustion in any open-hearth furnace. Then goes on describing particular feature of the new open-hearth furnace "Terni" built so that will give a better combustion of gases thus increasing the flame efficiency. GTM(23)

Some Remarks on Furnace Designs and Plant Layout. Walter Lister. *Metallurgia*, Vol. 2, Aug. 1930, pages 140–142.

The design of steel melting furnaces, including regenerators and valves is considered in some detail. Electric melting furnaces are also discussed. JLG(23)

Electric Furnaces for Heat Treatment. A. G. Lobley. *Electrical Review*, Vol. 106, April 11, 1930, pages 713–714; *Automobile Engineer*, Vol. 20, Mar. 1930, pages 110–111.

Paper read before meeting of Birmingham and Midland Section of the Society of Chemical Industry. MS(23)

The Poumay Cupola. John Cameron. *Foundry Trade Journal*, Vol. 42, May 8, 1930, pages 338–339, 340; May 22, 1930, pages 383, 384.

Includes discussion. Gives inventor's own explanation of the process. CO is burned to form CO_2 which is deliberately promoted in the melting zone. In other systems CO was considered harmful. Below the zone of fusion transformation of CO_2 into CO by two successive reactions takes place on account of the presence of incandescent coke at the level of tuyères $C + O_2 = CO_2$. CO_2 encounters the coke and is transformed into CO. Above the zone of fusion the CO is burned by the regenerative tuyères $CO + O = CO_2$. Compares it with the Greiner and Erpf system. Cupola using Poumay system contains less than one half the amount of FeO in slag of the ordinary cupola. Poumay cupola offers the following advantages: (1) Absence of oxidation between melting zone of the level of melting tuyères. (2) Reduction of S content. (3) Increased rate of melting. (4) Cleaner metal. (5) Reduction in loss of Si and Mn. Gives performance details. VSP(23)

REFRACTORIES & FURNACE MATERIALS (24)

New High-Refractory Materials. (Neuere hoch feuerfeste Stoffe.) Karl Becker. *Anzeiger für Hütten- und Maschinenwesen*, Vol. 52, Sept. 9, 1930, pages 5–6.

Describes a few materials suitable either as furnace lining or luminescent bodies which have a still higher melting point and a lower volatility than carbon, tungsten, tantalum or molybdenum. All these materials are carbides: tantalum-carbide melts at 4150° K, hafnium-carbide 4160°, zirconium-carbide 3805°, niobium-carbide 3770° K. A mixture of 4 parts tantalum-carbide to one part zirconium-carbide has a melting point of 4205° K., 4 parts tantalum-carbide to one part hafnium-carbide of 4215° K. At present, the great brittleness of these bodies prevents commercial application. Ha(24)

Refractories for Steel Works. (Eldfasta material i stalverk.) Kurd Endell. *Jernkontorets Annaler*, Vol. 114, July 1930, pages 336–355.

Summary of lectures given in Stockholm. Heat resistant materials are defined as those melting above Seger cone 26 corresponding to a temperature of 1530° C. The qualities to be examined are structure, chemical composition, porosity, specific gravity, melting point, deformation under load, swelling and expansion up to the highest operating temperature and brittleness with change in temperature. Qualities less readily examined, but important, are heat conductivity and resistance to slagging. A description is given of a bar press for measuring deformation under pressure, a furnace for measuring brittleness due to sudden temperatures and an apparatus for measuring coefficient of expansion. All these are obtained from Atom-Studiengesellschaft Berlin. It is concluded that the wearing qualities in use are determined not merely by the properties of the material but also by the conditions of operation. HCD(24)

Furnace Refractories for High Temperature Work. G. Junck. *Chemical Engineering & Mining Review*, Vol. 22, Aug. 5, 1930, pages 419–420.

An abstract of a paper read before the Society of Chemical Industry of Victoria. Three main classes of refractories are: (1) acid materials siliceous fireclays, ganister, etc. (2) neutral materials—chromite, graphite, silicon carbide, etc. (3) basic materials—dolomite, corundum, zirconia, etc. Fireclay is the most widely used refractory. Mullite refractories are made by heating clay and bauxite to 1600° C, obtaining the compound $3\,Al_2O_3\text{-}2SiO_2$. Mullite melts at 1850° C. and is highly resistant to abrasion and slagging by the usual fluxes. Pure sillimanite is the fused compound of a 50% SiO_2 and 50% Al_2O_3 mixture fusing at 1816° C. It has the very desirable property of remaining rigid to within a few degrees of its melting point. It is neutral, is highly resistant to spalling and has an exceptionally low coefficient of expansion. One of the latest developments is the electric furnace production of a synthetic spinel, by the fusion together of certain proportions of alumina and magnesia. The product is claimed to be exceptionally resistant to high temperatures, of high dielectric strength and of high heat conductivity. WHB(24)

GASES IN METALS (25)

Capacity of Iron to Absorb Hydrogen and Nitrogen. (Ueber die Fähigkeit des Eisens, Wasserstoff und Stickstoff aufzunehmen.) E. Martin. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, July 12, 1930, page 976.

The state of equilibrium in the absorption of hydrogen by pure electrolytic iron is very quickly reached; it takes nitrogen a little longer; while for oxygen 16 hours are required. Chromium absorbs less hydrogen than iron. Above 600° C. a nitride is formed with nitrogen. Molybdenum absorbs still less hydrogen and nitrogen than chromium. For 800° the hydrogen curve shows a maximum; nitrogen also shows a maximum near this temperature. When cooled under 800°, N was not liberated again. Tungsten absorbs neither H or N within the temperature range under test. 2 references. See *Metals & Alloys*, Vol. 1, Apr. 1930, page 479; Aug. 1930, page 684. Ha(25)

The Influence of Gases on Graphitisation in Cast Iron. *Metallurgist*, June 1930, pages 93–94.

A review of the literature on the above subject showing particularly the contradictory nature of the conclusions of the various investigators. VVK(25)

Determination of Gases in Metals, Particularly of Oxygen in Iron and Steel. Hans Diergarten. *Foundry Trade Journal*, Vol. 42, April 17, 1930, page 292.

Abstract translation of report No. 72 of Chemical Committee of the Verein deutscher Eisenhüttenleute on "The Determination of Gases in Metals Particularly of Oxygen in Iron and Steel by the Hot-extraction Process." Gives results of tests. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. VSP(25)

Gas Content of Vacuum-melted Metals. *Metallurgist*, Sept. 1930, page 144.

A comprehensive abstract of the paper communicated to the Ninth Congress of Industrial Chemistry, held at Barcelona in 1929 and reported in *Comptes Rendus*, Vol. 189, Aug. 12, 1929 by Villachon and Chaudron on preparing metals freef rom gases. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. VVK(25)

Oxides in Steel. *Metallurgist*, July 1930, pages 104–106.

An extended abstract of a paper by Diergarten on the "Estimation of Gases in Metals, Especially of Oxygen in Iron and Steel by the Hot Extraction Method" appearing in the *Archiv für Eisenhüttenwesen* for March 1930, pages 577–586. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. VVK(25)

Unsoundness in Bronze Castings. Edward J. Daniels. *Foundry Trade Journal*, Vol. 42, Apr. 3, 1930, pages 253–256.

Effects of gases on the soundness of bronze castings. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. VSP(25)

Solubility of Oxygen in Solid Iron. (Ueber die Löslichkeit des Sauerstoffs im festen Eisen.) W. Krings & J. Kempkens. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 183, Oct. 2, 1929, pages 225–250.

The Fe used was prepared by reduction of pure Fe_2O_3 in dry H_2 at 720–750°. The solubility of O_2 in this Fe was determined by means of equilibria experiments in a current of H_2-H_2O vapor at 715° and was found to be 0.11 ± 0.015%. The same experiments served for a study of the equilibrium $FeO + H_2 \rightleftharpoons Fe + H_2O$. (25)

Action of Carbonic Acid under High Pressures on Iron. (Ueber die Einwirkung von Kohlensäure unter hohem Druck auf metallisches Eisen.) Ernest Müller & Hans Henecka. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 181, June 28, 1929, pages 159–171.

Under high pressures of carbon dioxide, e. g., 20–50 atmospheres, carbonic acid reacts on aqueous suspensions of metallic iron to produce soluble ferrous hydrogen carbonate. As the concentration of the hydrogen carbonate ion increases, hydrogen-ion concentration of medium decreases and the rate of dissolution of iron approaches zero. (25)

Gases in Copper and Their Removal. W. E. Prytherch. *Foundry Trade Journal*, Vol. 42, Mar. 27, 1930, pages 229–230.

Effects of oxygen, hydrogen and sulphur dioxide on the soundness of copper castings. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. VSP(25)

Gases—Metals—Alloys. Smelting and Foundry Questions. (Gase—Metalle—Legierungen. Schmelzerei- und Giesserei-fragen.) WILLI CLAUS. *Giesserei*, Vol. 16, Oct. 18, 1929, pages 976–981; Oct. 25, 1929, pages 1000–1003.

Problems of melting and casting are taken up, among which are these: reversible and irreversible gas-dissolving phenomena in molten metals; law of solubility; gas separation; gas porosity as function of degree of saturation; speed of cooling; solidification and diffusion; deoxidation, desulphurization and decolorization. Bibliography given. (25)

Equilibrium Studies of the Reduction, Oxidation and Carbonization Processes of Iron. VIII. 9. The System Iron–Oxygen. (Gleichgewichtsuntersuchungen über die Reduktions-, Oxydations-, und Kohlungsvorgänge beim Eisen. VIII. 9. System Eisen-Sauerstoff.) RUDOLF SCHENCK, TH. DINGMANN, P. H. KIRSCHT & H. WESSELKOCK. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 182, Aug. 17, 1929, pages 97–117.

The object was to study the minima attained in the oxidation of Fe with small quantities of CO_2 and their dependence upon the O_2 content of the basic material. The O_2 saturation of the homogeneous oxyferrite phase at different temperatures was likewise determined. The metal used in the experiments was carefully freed of H_2 by many days heating in a high vacuum while the gas used was pure CO_2 gas under diminished pressure or, in a few cases, mixtures of CO_2 and CO. At 700° the reaction velocity was very slow, while at 1000° the stable zone was reached in the course of the first day. The stable Wüstite-oxyferrite equilibrium corresponds at 700° to a gas phase compound of 40.3% CO_2 and 59.7% CO, at 800° to 35.1% CO_2 and 64.9% CO and at 1000° to 28.5% CO_2 and 71.5% CO. At 800 and 1000°, the O_2 taken up in homogeneous solid solution is about 0.4%, the higher values previously obtained being due to the occurrence of the metastable Wüstite, low in Fe_3O_4. With mixtures of CO_2-CO, the relation between CO and CO_2 in the gas phase was determined along the stable Wüstite-oxyferrite boundary. The new values for maximum O_2 content require a diminution in the extent of the oxyferrite zone in the Fe-O equilibrium diagram. The possibility of preparing FeO in the pure state is discussed, and it is suggested that small additions of MgO or MnO would increase the stability of FeO. Addition of 0.5, 1.0 and 4.0% Cu as well as 4% Ni was studied, and resulted in a slight displacement of the Wüstite-oxyferrite border toward higher CO_2 concentration, as well as a more rapid attainment of the stable Wüstite-metal boundary. The solubility of O_2 is reduced more than 50%. (25)

INSPECTION (26)

Methods for the Identification of Aircraft Tubing of Plain Carbon Steel and Chromium Molybdenum Steel. W. H. MUTCHLER & R. W. BUZZARD (Bureau of Standards). *National Advisory Committee for Aeronautics, Technical Note* No. 350, Oct. 1930, Mimeographed, 27 pages. 27 references.

Shop tests for the routine inspection of aircraft tubing, to prevent mix-ups of carbon and Cr Mo tubing were examined. Chemical spot tests are so far not very promising. Magnetic examination is considered promising, but its practicability would require further investigation. Rockwell hardness testing as advocated by Knerr, is now in use, and meets some requirements. Spark testing is considered the most applicable. It is stated that the damage done in grinding for spot testing is negligible. (There would seem to be room for fatigue tests to establish this, abstractor.) The accuracy of the spark test in the hands of inexperienced operators is discussed, and details of the procedure given. HWG(26)

Spark Testing of Metals. *American Machinist*, Vol. 72, April 24, 1930, page 703.

Spark testing is a reliable and adaptable method of classifying slightly different steels, in checking mixed stocks, in testing decarburization depth and in determining the quality of metal in a weld. Applicable cheaply and rapidly to large quantities. Gives chart and table showing and describing the appearance of the sparks. These charts and tables are explained more fully in the text of the article. RHP(26)

EFFECT OF ELEMENTS ON METALS & ALLOYS (27)

Lead in Cast Brass and Bronze. H. C. DEWS. *Metallurgia*, Vol. 2, July 1930, pages 81–83.

Specifications for cast brass and bronze often require an unnecessarily low lead content. The effect of lead on the mechanical properties is dependent on the rate of cooling. The hardness of all brasses and bronzes is reduced by the addition of lead. As little as 0.5% lead improves the cutting properties, but further improvement is gained by increasing the lead up to 2%. JLG(27)

The Influence of Silicon Content and Cooling Speed on the Constitution of the Phosphide Eutectic in Cast Iron. (Der Einfluss des Siliziumgehaltes und der Abkühlungsgeschwindigkeit auf die Konstitution des Phosphideutektikums im Gusseisen.) P. BARDENHEUER & M. KÜNKELE. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, *Report* No. 146 (1930), pages 33–38; *Stahl und Eisen*, Vol. 50, Aug. 21, 1930, page 1208.

Silicon and cooling speed have the largest bearing on crystallization of graphite. The influence of these 2 factors on the phosphide eutectic was therefore studied. Samples in wedge shape with an approximate content of 2% P and with increasing silicon content from 0.1–6% were examined. Up to 2% Si, the alloys contained, when poured in green sand, the ternary eutectic of phosphide. The pseudo binary eutectic appears at higher silicon content. Manganese up to 0.7% has no essential influence on this limit. The cooling velocity has only a small influence on the constitution of the phosphide eutectic. When the samples are poured into dry molds or molds heated up to 300° C. the formation of the pseudo binary eutectic already starts at 1.5% Si. This holds only for contents of phosphorus above 2%. For lower contents of phosphorus the ternary eutectic crystallizes also in higher silicon alloys. A higher carbon content favors the crystallization of the pseudo binary eutectic. GN(27)

Alloy Cast Irons. J. W. DONALDSON. *Metallurgia*, Vol. 2, July 1930, pages 103–104.

Contains bibliography of 17 references. Discusses effects of nickel, chromium and nickel plus chromium on gray iron. There has been little practical application of other elements in gray cast iron. JLG(27)

Effect of Certain Alloying Elements on Structure and Hardness of Aluminum Bronze. SELMA F. HERMANN & FRANK T. SISCO (Wright Field). *American Institute Mining & Metallurgical Engineers, Technical Publication* 365 (1930) 23 pages.

The effects of 5 different alloying elements on aluminum bronzes were determined by microscopic examination and in some cases hardness tests. The alloys contained 8, 10 and 12% aluminum with 1 and 5% alloying element. The 5 elements were nickel, iron, manganese, cobalt and silicon. With 5% nickel an additional phase was formed. Hardness results on the nickel alloys were erratic. Manganese shifted the equilibrium diagram to the left, i. e. it acted to increase the amount of aluminum. Iron had little effect on the microstructure, but decreased the grain size. Cobalt increased the hardness, had little effect on the grain size and shifted the diagram to the right. Silicon shifted the diagram to the left and greatly increased the hardness. All alloys containing 5% silicon were very brittle. Contains 3 references. JLG(27)

Copper-Base Alloys Containing Beryllium. (Ternäre, Beryllium enthaltende Legierungen auf Kupferbasis.) G. MASING & O. DAHL. *Wissenschaftliche Veröffentlichungen des Siemens-Konzern*, Vol. 8, No. 1 (1929) pages 202–210.

The addition of Be to α-solid solution alloys of Cu with Sn, Zn or Al causes them to undergo age-hardening after quenching from 700 – 800°. The presence of a third metal reduces the solid solubility of Be in Cu so that smaller quantities of Be are necessary to produce the maximum hardening than are required in the case of Cu. With α-brasses with a high Zn content a small addition of Be increases the hardness of the quenched alloy considerably and subsequent aging causes only a relatively small increase. Addition of less than 1% Al to the 2–2.5% Be-Cu alloys accelerates the age-hardening without intensifying the action. (27)

Aluminum-Beryllium Alloys with an Appendix on Silicon-Beryllium Alloys. (Berylliumhaltige Aluminiumlegierungen mit einem Anhang über Silizium-Berylliumlegierungen.) G. MASING & O. DAHL. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 8, No. 1 (1929), pages 248–256.

The age-hardening properties of Cu-Al alloys are not improved by the addition of Be; Be cannot be used as a substitute for Mg in alloys of the type of aludur and aldrey. Si and Be form a eutectic with 39% Be, but not compounds or solid solutions. All the alloys are extremely hard and very brittle. (27)

The Decrease of Solution Speed of Zinc by Alloying with Cadmium. (Die Hemmung der Auflösungsgeschwindigkeit des Zinks durch Legieren mit Kadmium.) M. STRAUMANIS. *Zeitschrift für physikalische Chemie*, Vol. 6, Sec. A, June 1930, pages 112–124.

The solution speed of Zn-alloys with Pt, Ni and Fe is considerably, and those with Au and Cu extremely reduced by additions of Cd. In case of the alloy Zn-Au-Cd only 0.2% of Cd need be present to materially retard the dissolving of the alloy. The reasons accounting for the effect produced by Cd are established by studying single crystals of the alloys, and the formation of "layer-like" crystals during solidification of the melt is discussed. The order of metals cutting down the solution speed of Zn is as follows: Al, Mg, Pb, Te, Cd, Hg if a Zn-Au alloy is used. The protecting effect of Cd depends on the speed of solidification of the alloy. The elements Hg, Cd, Te and Pb alloyed with Zn do not accelerate the dissolution which is increased to a small extent by As and Ag. Zn does not form solid solutions with Cd, not even below 0.1% Cd. EF(27)

The Influence of Nickel and Chromium on the Properties of Malleable Iron. (Influence du nickel et du chrome sur les propriétés de la fonte malléable.) LEON THIERY. *Comptes Rendus*, Vol. 191, July 7, 1930, pages 47–49.

The properties of the cast iron of the composition C 3.15, Si 0.47, Mn 0.21, S 0.06, P 0.095 to which different amounts of Ni were added was studied before and after annealing corresponding to the malleabilizing cycle. The presence of Ni results in the precipitation of graphite on this treatment, the particle size of which is inversely proportional to the amount of Ni present, resulting in a fine structure much improving the physical properties, up to 2% Ni. A table of physical properties is given. JDG(27)

Copper Used in Special Structural Alloy Steels Developed in France. *American Metal Market*, Vol. 37, July 18, 1930, page 2.

Special structural steels are being manufactured in France to offset foreign competition. As a result of researches, the new steel has a chemical composition about as follows: chromium 0.4–0.6%, copper 0.3-0.5%, sulphur 0.06% maximum, and phosphorus 0.07% maximum. It is mechanically about 1½ times stronger than ordinary structural steel. This steel offers no special difficulty in rolling of bars and possesses great homogeneity throughout the bar and conserves the general properties of mild steel. It can be cut, punched and worked either hot or cold with ease in conditions comparable with those of mild steel WHB(27)

Report of Research Committee on the Effect of Tin and Arsenic on High-Speed Tool Steel. *Reprint Proceedings American Society for Testing Materials*, Vol. 29, Part I (1929) 5 pages.

This report gives the composition of various high-speed steels and results of the testing of 2 types which show, among other things, arsenic and tin in amounts of 0.50% in high-speed steel noticeably embrittle the steel. The hardness of annealed steel is comparable to that of regular high-speed grade. (27)

Silicon Brasses. *Metallurgist*, June 1930, pages 95–96.

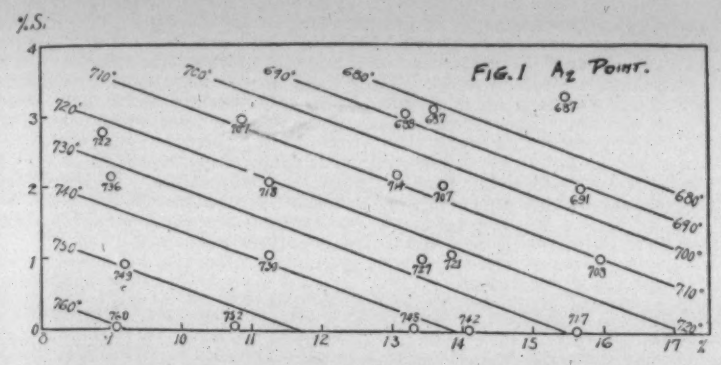
An extended abstract of the article by H. W. Gould and K. W. Ray in *Metals & Alloys*, Vol. 1, April, 1930, pages 455–457; May, 1930, pages 502–507. See abstract in *Metals & Alloys*, Vol. 1, Aug. 1930, pages 685. VVK(27)

The Influence of Nickel and Manganese on the Properties of High Speed Steels. (Ueber den Einfluss von Nickel und Mangan auf die Eigenschaften von Schnelldrehstahl. Ein Beitrag zur Klärung der Anlassvorgänge im Schnelldrehstahl sowie seiner Eigenart als warmfester Stahl.) V. EHMCKE. *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 23–35; *Stahl und Eisen*, Vol. 50, Aug. 7, 1930, pages 1131–1132. 17 references.

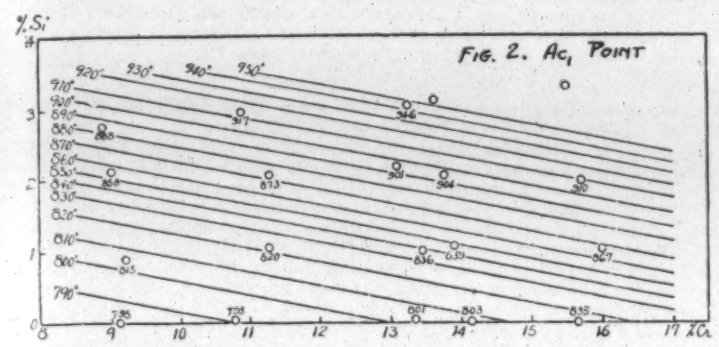
The fact that stability against drawing as well as hardness at elevated temperatures of a hardened high speed steel are favorably influenced by an increasing quenching temperature (increasing amount of austenite) lead to this investigation which covers common high speed steels with nickel contents of 2 to 15%. For comparison a common nickel-free high speed steel and a 10% straight nickel steel were examined. Hardness and annealing tests show that the hardness decreases with increasing nickel content. Steels with 5% and more nickel are austenitic when quenched from high temperatures, therefore giving rather low hardness numbers (300 Brinell and lower). In annealing between 600 and 900°C. the austenite is decomposed to martensite thus increasing the hardness to 575 Brinell for the 5% nickel high speed steel. Manganese high speed steels are similar to nickel high speed steels. Dilatometric measurements were carried on which prove that the transformation austenite to martensite in Ni high speed steels takes place during cooling within a critical range. This temperature range is 700 to 900° C. for the 5% and more Ni steel, around 600° C. for a 3% Ni steel. The decomposition taking place at these temperatures (secondary hardness) essentially results in a precipitation of carbides which has its bearing on the stability of the austenite. Martensite crystallizes, therefore, in cooling Ni- and Mn high speed steels in the martensitic state offer no increased stability toward annealing compared with common high speed steels. Dynamic and static hardness tests and hot tensile tests were carried on to determine the hot tensile properties in relation to the nickel content. The tests show that hardness and tensile strength up to 600 and 700° C. are lower than those of a regular high speed steel. At still higher temperatures, however, nickel alloy steels are superior to nickel-free high speed steels. An austenitic manganese high speed steel is absolutely similar to the nickel steel as regards hot tensile properties. This proves that the austenitic state determines the superior hot tensile properties in the temperature range above 650° C. GN(27)

The Effect of Silicon on the Transformation Points and the Structure of High Chromium Steels. TAKEJIRO MURAKAMI & KINJI YOKOYAMA. *Kinzoku no Kenkyu*, Vol. 7, Sept. 20, 1930, pages 451–466.

Using 20 specimens containing about 0.3% C and ranging from 9 to 16% Cr and less than 3% of Si, the effect of Si on the transformation points and the structure of high Cr steels was studied. The A_2 point was determined by magnetic analysis; the result is shown in an isothermal diagram, Fig. 1, for the A_2 point from which we see that the A_2 point is lowered with increasing



Si and Cr contents. The A_3 and A_1 points were determined by measuring the thermal dilatation during heating and cooling at very slow rate. As the Si and Cr contents increases, these transformations decrease in magnitude until these vanish, the temperatures of the changes being raised. Fig. 2 shows the isothermal diagram for the starting point of the Ac_1 change in these specimens. The microstructures of the specimens, annealed or quenched from several temperatures were observed, and several sectional diagrams with constant Si or Cr content, and isothermal diagrams were constructed, in which the change of structure due to the change of compositions or temperatures is clearly demonstrated. By adding silicon up to



3%, no special structural constituent is observable, the silicon being dissolved in the iron. The composition range of alloys consisting of the γ-phase alone at high temperature extends toward high chromium content as the Si content increases. The carbon content at the eutectoid composition decreases by adding Si. TM(27)

Effects of Nickel upon Malleable Cast Iron. *Metallurgia*, Vol. 2, June 1930, pages 67–68.

The effects of up to 3 or 3.5% Ni on the mechanical properties of white-heat malleable castings have been determined by J. V. Murray. The castings were made both from cupola and crucible melted iron. Ni when added in amounts up to 1% increases the tensile strength. Generally the addition of nickel lowers the elongation and the bending angle. The best mechanical properties were obtained with 1% Ni. A cupola melted iron containing no Ni had a tensile strength of 21.3 tons/in.², an elongation of 6.5%, and bent 67°. A similar iron containing 1% Ni had a tensile strength of 25.4 tons/in.², an elongation of 4.5%, and bent 33°. JLG(27)

Special Steels. *Mining Journal*, Vol. 169, June 28, 1930, pages 17–18, 20.

A discussion of the effect of the addition of various amounts of other metals on the properties of steel and the chief uses for the resulting products. AHE(27)

The Use of Vanadium in Metallurgical Industry. (Memoire sur l'emploi du Vanadium dans l'industrie siderurgique.) E. B. SAKLATWALLA, J. STRAUSS, H. CHANDLER & G. NORRIS. *Aciers Speciaux, Métaux et alliages*, Vol. 5, Sept. 1930, pages 390–406.

Ferro-vanadium generally used in United States contains 35–45% vanadium, and that used in Europe 45–55%. Ferro-vanadium containing 35–45% vanadium melts at 1425° C. and easily soluble in molten steel. Ferro-vanadium can be added in crucible with the charge; in electric furnace, about 15 minutes before tapping; in open-hearth, to the ladle. There is a recovery of 95–100% in electric furnace and crucible process, and 85–95% in the open-hearth. Vanadium produces a fine structure in steel, with less tendency for dendritic segregation. Typical vanadium steel contains 0.10–1.05% carbon and 0.15–0.18% vanadium, while in tool steel vanadium content varies from 0.20 to 1.00%. The effect of vanadium steel is emphasized by the proper heat treatment. Steels used for construction purposes contain Ni, Mn, Mo, Si or Cr besides carbon and vanadium. GTM(27)

INSTRUMENTS & CONTROLLERS (28)

The Determination of the Calorific Value of Coke Oven Gas in the Junker Calorimeter. (Die Heizwertbestimmung von Koksofengas mit dem Junker'schen Heizwertmesser.) H. GREWE. *Archiv für Eisenhüttenwesen*, Vol. 4, Aug. 1930, pages 75–85; *Stahl und Eisen*, Vol. 50, Sept. 4, 1930, pages 1269–1270.

Report 77 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. The general principles for the determination of the calorific value of gases are outlined. These are: (1) gas, combustion air and waste gas must have the same temperature; (2) gas, combustion air and waste gas must be completely saturated with water vapor; (3) the vaporization heat of the contraction water must be subtracted from the upper calorific value. Junker's Calorimeter can be easily equipped with a device for moistening the combustion air, thus fulfilling the above outlined requirements. New devices for moistening the air and cooling the waste gases have been designed and described. A new device has, furthermore, been constructed for a reliable checking of the gas quantity to be burned. GN(28)

Apparatus for Electroplating Solution Control. *Brass World*, Vol. 26, July 1930, pages 191–192.

Eimer & Amend, N. Y. City have marketed the Pitschner electroplating outfit which is an apparatus for electrometric control of nickel plating solutions. Its installation and operation are described. WHB(28)

Chromic Acid Determination Outfit. *Brass World*, Vol. 26, Aug. 1930, page 213.

The Kocour Co., Chicago, Ill. offers a simple apparatus for determining the chromic acid content of a plating solution. The method involves the permanganate-ferrous sulphate titration, and provides direct readings in ounces per gallon. The outfit is illustrated. WHB(28)

A New Portable Immersion Pyrometer. *Instruments*, Vol. 3, No. 7, July 1930, pages 478–479.

A "cave" type thermometer enclosed in a sheath of low thermal lag and equipped with self-contained indicator handle is described for use in obtaining pouring temperatures. Manufactured by Illinois Testing Laboratories, Inc. WHK(28)

Comparison of Fused Silica, Gold and Platinum Linings for Calorimeter Bombs. OSCAR KENNETH BATES. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, April 15, 1930, pages 162–164.

The heating values of the different coals as determined by the Emerson bomb lined with vitreosil agreed very closely with those determined using a platinum lined bomb. The values obtained with the bomb lined with gold backed by silver agreed satisfactorily with the vitreosil lining for low sulphur content samples, but differed when samples of high sulphur content were used. This indicates that additional heat is evolved by reactions in which the lining plays the important part. This additional heat was not evolved when the vitreosil and platinum linings were used. MEH(28)

A Temperature Controller at McGill University. GORDON SPROULE *Metals & Alloys*, Vol. 1, June 1930, pages 554–555.

The work requiring annealing of malleable cast iron by students has been improved and facilitated through the design of an attachment for a Leeds and Northrup potentiometer recorder to make it control the tool type Hump furnace in which the annealing was carried out. The attachment is described. ESC(28)

Measurement of Corrosion with the "Corrosimeter" of Dr. Toedt. (Die Messung der Korrosion (Rostens von Metallen) mit dem Korrosimeter nach Dr. Tödt.) G. GOLLNOW. *Zeitschrift für Feinmechanik und Präzision*, Vol. 38, Aug. 31, 1930, pages 2–4; *Chemiker Zeitung*, Vol. 54, Feb. 5, 1930, page 110.

The instrument is based on the fact that by placing the sample and a nobler metal together in a water solution and connecting them through a galvanometer, the current then flowing gives a direct measure for the amount of corrosion going on under the prevailing condition. As usually the corrosion is expressed by the loss of weight in g./day and surface. The instrument is calibrated directly in loss of weight in g. The very simple arrangement is described in detail. Ha(28)

Deterioration of Thermo-Couples. *Metallurgist*, July 1930, pages 102–103.

A critical abstract of "The influence of atmosphere, temperature and material of protecting tube on the permanence of platinum thermocouples' by F. Stäblein and J. Hinnüber in the June issue of the *Archiv für Eisenhüttenwesen*. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. VVK(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The Effect of Temperature upon the Torsional Modulus of Spring Materials. F. P. ZIMMERLI, W. P. WOOD & G. D. WILSON. *Engineering*, Vol. 130, Aug. 29, 1930, page 281.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789 LM(29)

The Strength of Steels at High Temperatures. HOUDREMONT & EHMCKE. *Metallurgist*, Oct. 1929, pages 155–156.

The authors have taken as a basis of comparison tensile strength as determined in tests occupying 15 to 20 minutes. Considering first the lower temperature region, it has been shown that proportionality exists for steels of pearlitic nature between creep strength at 500° C. and yield point at room temperature. (29)

Working Stresses for Steel at High Temperatures. D. S. JACOBUS. *Advance Paper* No. 22, *American Society of Mechanical Engineers*, Dec. 2–6, 1929, 5 pages.

The results of practical experience set the maximum working stresses up to temperatures of 800° F. Above this, working stresses are scaled down in proportion to falling off of stresses producing creep. The first curve of creep points published by J. J. French is used and the working stresses for given temperatures are taken at ²/₃ creep-point stress. The effect on stress of piercing boiler shell with holes and of transmitting heat through equalization of stress through extension of most-strained fiber is discussed. (29)

Physical Properties of Boiler Sheets at Elevated Temperatures, with Special Reference to the Relation between Hot Yield Point and Tensile Strength at Room Temperature. (Festigkeitseigenschaften von Kesselblechen bei erhöhten Temperaturen, mit besonderer Berücksichtigung des Verhältnisses der Warmstreckgrenze zur Zugfestigkeit beim Raumtemperatur.) F. KÖRBER & A. POMP. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, *Report* No. 144 (1930) pages 13–22.

Four types of boiler sheets, with carbon contents between 0.08% and 0.24%, manganese between 0.36% and 0.66% and partly containing silicon were tested at room temperature, 300° C., 350° C., 400° C. and 500° C. It was found in accordance with former investigations that there is a relation between hot yield point and tensile strength at room temperature, so that the yield point at higher temperatures up to 500° C. can be approximately calculated from the tensile strength at room temperature. GN(29)

Contribution to the Knowledge of Graphite Precipitation in Cast Iron and its Effects. (Beiträge zur Kenntnis der Graphitabscheidung im Gusseisen und deren Auswirkungen.) E. PACK. *Dr.-Ing. Thesis, Technische Hoch Stuttschulegart* (1927) 88 pages.

Pack's investigation on the influence of superheating temperature and cooling velocity on the graphite crystallization pertains to a subject which has interested the cast iron foundryman for a number of years. The influence of the mentioned factors on the graphite crystallization has been studied by other investigators before Pack, so that it is of interest to know how his results check with these. The author studied the problem from a standpoint which guaranteed an absolutely uninfluenced process of crystallization. For this reason the melted samples were not cast in molds or quenched but cooled in the crucible. The tests cover two groups. In the first group the carbon content was kept constant whereas the silicon content was gradually changed from 0.5 to 3%. The second group covers experiments with cast irons of constant silicon content around 3% and varied carbon content from 3.0–1.5%. The statement that an increasing temperature of superheating refines the graphite as well as the findings on the change of the eutectic temperature with increasing superheating temperature are in agreement with Piwowarsky's results. On the other hand, Piwowarsky's findings on the course of the curve for combined carbon in relation to superheating could not be confirmed; these curves showed an irregular course which is due, according to the author's opinion, to the crystallization of primary graphite which decreases the amount of eutectic graphite. The theory and results of Hanemann, too, are only partly confirmed. Contradictory to Hanemann, the crystallization of eutectic graphite was found to be independent of the cooling rate. Some tests on shrinkage and abrasion are included, which illustrate the importance of the graphite size on the characteristics of cast iron. GN(29)

Permanence of Dimensions under Stress at Elevated Temperatures. W. H. HATFIELD (Brown-Firth Research Laboratories). *Iron & Steel Institute, Advance Copy* No. 2, Sept. 1930, 18 pages; *Engineer*, Vol. 150, Sept. 16, 1930, page 345.

Contains bibliography of 35 references. Engineering experience has proved, that for practical purposes, permanence of dimensions is attained within measurable accuracy over long periods of time at atmospheric temperature. An attempt has been made to determine the stress below which permanence of dimensions will attain at elevated temperatures for various steels. The value "time-yield," proposed by the author, is the stress within which, at the given temperature, stability of dimensions is attained within a period of 24 hours for a further period of 48 hours; the extension not to exceed the elastic deformation of 0.5% and with limitation as regards measurements of permanence of dimensions of the order of one millionth of an inch per hour. The author considers that a safe stress, for designing purposes, is two-thirds of the time-yield. Time-yield values for temperatures from 300 to 700° C. are given both for carbon and alloy steels. With carbon and low alloy steels no outstanding values were obtained. None of these steels had a value of over 3 tons/in.^{2} at 550° C. At 500° C. a Ni-Cr-Mo-V steel showed some merit. In the highly alloyed steels a Ni-Cr-W alloy had high time-yield values, giving 12.6 tons at 400° C. Die and high speed steels did not have high values. The time-yield values obtained together with the chemical analyses of the steels are given in tables. LFM+JLG(29)

LEACHING (30)

Innovations in Copper Leaching Employing Ferric Sulphate-Sulphuric Acid. HARMON E. KEYES. *Bulletin* 321, *United States Bureau of Mines*, 1930, 67 pages.

Autoxidation of ferrous sulphate and sulphur dioxide in the presence of air forms ferric sulphate and sulphuric acid. The ferrous sulphate comes from discard solutions; the sulphur dioxide comes from pyrite, sulphur or roaster gases. Iron is first oxidized; then sulphuric acid is produced. Most copper minerals dissolve in this reagent (chalcopyrite and certain silicates are exceptions). The complete process, from acid making to copper precipitation, was successfully carried out on a test-plant scale on a number of ores. No soluble impurities were found which prevented regeneration of the barren solutions. Plant results are given The mechanism of percolation leaching was also studied. In flood leaching the fines cause channeling, which lowers extraction. This effect can be minimized by agglomeration of the charge before leaching. The fine particles are made to adhere to larger particles, the glomerule behaving as a large particle and the solution passing easily. (Includes 27 footnote and bibliographic references.) AHE(30)

Methods and Costs of Treatment at the Calumet and Hecla Reclamation Plant. C. HARRY BENEDICT. *Information Circular* 6357, *United States Bureau of Mines*, September 1930, 11 pages.

Tailing dumps are being reworked by leaching (80%) and flotation (20%) to recover 90% of the copper in the dumps. This results in a total recovery of 95% of the metal in the ore. In 1929, heads assayed 0.973% copper, tails 0.120%. Almost 26,000,000 pounds of copper were produced, 16.81 lbs./ton treated, at a cost of 2.94 cents per pound of copper and 49.5 cents per ton of material dredged. This was divided as follows (in cents): administration 3.8, dredge and pontoons 5.6, shore plant and belt conveyor 2.5, regrinding 17.2, leaching 17.8, flotation 1.8 and miscellaneous 0.8. AHE(30)

Investigations on the Dressing of Raw Beryl and on the Production of Beryllium Salts Suitable for Electrolysis. (Versuche zum Aufschluss des Rohberylls und zur Herstellung geeigneter Berylliumsalze für die Elektrolyse.) K. ILLIG, M. HOSENFELD & H. FISCHER. *Wissenschaftliche Veröffentlichungen des Siemens-Konzern*, Vol. 8, No. 1 (1929) pages 30–41.

For the large-scale preparation of Be compounds from beryl the most satisfactory method comprises heating an intimate mixture of the finely powdered mineral with an equal weight of Na_2SiF_6 for several hours at 650° and leaching the product with cold water. Extraction of over 90% of the beryllia accompanied by a little Fe and only traces of Al is thus readily effected. A higher temperature results in fusion of the mass and a lower extraction. Evaporation of the leach liquors gives a crop of large crystals of Na fluoberyllate, Na_2BeF_4, which are purified by dissolving in water, bubbling air through the liquor to remove Fe, and again crystallizing. Practically the whole of the Be may be recovered by saturating the mother liquors with NaF. Complete precipitation of beryllia from fluoberyllate solutions by NH_3 is obtained only by using a ten-fold excess; additions of a slight excess of lime, however, effects complete precipitation of the hydroxide in a granular form. The washed precipitate is treated with HF and the residual CaF_2 removed by decantation. The solution is evaporated to dryness on the water bath and the residue heated at 150°, whereby the oxyfluoride, $2BeO.BeF_2$, is obtained. Extraction of the residue with an equal weight of hot water dissolves all the oxyfluoride, leaving NaF and CaF_2 insoluble. Evaporation of the filtered solution affords the pure salt as a snow-white powder; mixed with barium fluoberyllate the salt forms a readily fusible electrolytic bath for the production of the metal. Methods are also described for the preparation of the double fluorides, $NaBeF_3$, $BaBeF_4$ and $BaBe_2F_6$. 19 references. (30)

REDUCTION METALLURGY (31)

Some Remarks on the Reactivity of Metallurgical Coke. (Note sur la reactivite des cokes metallurgiques.) DUFRAINE. *Revue de Metallurgie*, Vol. 27, Sept. 1930, pages 509–511.

The reactivity of coke (its capability to react with CO_2) is inducive to high blast furnace efficiency. Considerations are advanced to prove this point. The determination of the change of reactivity on account of the presence of non-organic substances in the coke was made by soaking different cokes in watery suspensions of cement, a mixture of cement with iron ore and a mixture of cement with limestone, which was followed by drying and heating in an electric furnace at different temperatures. Analysis of the gases produced showed that the treatment reduces the reactivity of the coke. JDG(31)

The Gas Distribution in the Blast Furnace Shaft. (Beitrag zur Frage der Gasverteilung im Hochofenschacht.) J. STOECKER & H. CORNELIUS. *Stahl und Eisen*, Vol. 50, Aug. 28, 1930, pages 1217–1221. 4 references.

Report 114 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Composition, temperature, pressure and velocity of blast furnace gases were measured in the upper part of the shaft. The measurements were taken at locations at various distances between wall and center of the furnace. The results lead to the conclusion, at least as far as the examined furnace is concerned, that the charge is less dense near the wall and in the center of the furnace than in the ring-like zone between wall and center The denser sections in the charge show increased indirect reduction as indicated by a lower temperature and lower content of carbon monoxide. Experiments to determine the volumetric distribution of the gas over various furnace sections have not been successful. GN(31)

The Modern Blast Furnace and Its Operation. R. A. HACKING. *Metallurgia*, Vol. 2, May 1930, pages 27–28; July 1930, pages 99–100, 104.

The amount of air entering the blast furnace is about 5.8 times the weight of carbon burned. Increasing air-blast temperature has the following effects: (1) the additional sensible heat of the blast is added without increased amounts of material, which theoretically raises the temperature in the combustion zone, (2) the speed of reaction is increased, thereby decreasing the dimensions of the combustion zone, (3) the number of thermal units added per unit of carbon burned is increased. The chief reason for economy of the hot blast lies in the intensity of temperature in the hearth. The limit of air-blast temperatures lies at about 1150° F. with basic iron using ungraded ores, and about 1400° F. in the case of foundry and hematite practice. The use of bosh tuyères is discussed. Water vapor in the blast reduces the temperature in the combustion zone due to the endothermic reaction of water vapor with carbon. Theoretically each grain of water per cubic foot of air lowers the temperature 23 or 27° F. Increase in moisture content of 3 gr./cu. ft. has the same effect as lowering the blast temperature 80 or 90° F. The blast can be dried either by absorption or refrigeration. Refrigeration has been abandoned as uneconomical. Recently drying with silica gel has been applied at the Wishaw plant of the Glasgow Iron and Steel Co., with an increase in output of 13% and a decrease in fuel consumption of 5%. It is probably more economical to increase the blast temperature than to dry the blast. Contains 2 references. JLG(31)

The Thermal Reduction of Beryllium. (Herstellung von Beryllium auf thermischen Wege.) K. ILLIG & M. HOSENFELD. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 8, No. 1 (1929) pages 26–29, 20 references.

Brief descriptions of the known methods for the production of beryllium. This article is only of historical value as beryllium cannot be produced commercially by any of the methods described. (31)

Sponge Iron and Its Relation to the Steel Industry. EDWARD P. BARRETT. *Mining & Metallurgy*, Vol. 11, Aug. 1930, pages 395–396.

It is questionable whether or not high-grade sponge Fe can be produced from low-grade materials. Sponge Fe containing small amounts of S can only be made from raw materials containing small amounts of S or by some special process in which S is removed from reducing gases prior to their contact with Fe_2O_3. There are many variables in making estimate of the cost of producing sponge iron. They are: raw materials, plant and operation. Gives an abstract of Rohland's paper which was abstracted in *Metals & Alloys*, Feb. 1930, page 390, on experiments with sponge Fe. VSP(31)

Rolling Process for Production of Metals. (Das Wälzverfahren zum Gewinnen von Metallen.) R. HOFFMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 72, July 26, 1930, pages 1041–1048.

A process for obtaining metals or alloys from ores, which has gained a very wide application since 1924, consists in the following: the raw material mixed with fuel and eventually other additions are charged dry or wet on one end of a slightly inclined drum, and progress uniformly through the furnace; and the necessary air passed through the drum in a counter-current. As the material is forced by the rotation of the drum, to roll over and over continually, this process is called the rolling process. The raw-materials which are particularly suitable for this process are zinc and lead ores, residues and ashes of brass, electrolytes and poor ores. The paper describes in detail equipment, chemical and metallurgical behavior of the different materials and gives operating data. The author believes this method to be very promising. Ha(31)

What Reasons Compelled the Prague Ironworks Company to Introduce Thin-Walled Blast-Furnaces? JINDRICH SAREK. *Iron & Steel Institute, Advance Copy* No. 7, Sept. 1930, 33 pages; *Engineer*, Vol. 150, Sept. 26, 1930, pages 344–345; *Engineering*, Vol. 130, Sept. 19, 1930, pages 371–372.

There are now 4 thin-walled blast furnaces in operation at the Prague Ironworks, and one more being installed. The furnaces operate on lean ores, and have been very satisfactory. The operation of the blast-furnace is discussed in some detail. Two different modes of blast-furnace working are described as internal and external. Coke consumption has been lessened by the thin-walled furnaces, and the linings have worn uniformly. LFM+JLG(31)

The Modern Blast Furnace and Its Operation. Part V. R. A. HACKING *Metallurgia*, Vol. 2, Sept. 1930, pages 177–178.

This article covers: the use of oxygen enriched blast, theoretical consideration, future possibilities, effect of increased blast pressure influence of increased blast velocity and practical considerations. It was observed that each one percent increase by weight in the oxygen content of the blast raises theoretical temperature of combustion by approximately 125° F., and reduces the moisture content by 5 grains/cubic foot. It is stated that enrichment up to 25% of oxygen enabled the stoves to be dispensed with, and a higher grade of pig iron to be produced. GTM(31)

Zinc Smelting from a Chemical and Thermodynamic Viewpoint. C. G. MAIER. *Bulletin* 324, *United States Bureau of Mines* (1930) 93 pages.

This paper shows in detail the application of newly recalculated theoretical data (especially thermodynamic) to the general chemistry of zinc reduction. The free energy of formation of zinc oxide was obtained by four independent methods. Chapter headings are: thermodynamic properties of zinc and its compounds; zinc oxide and carbon; direct smelting for liquid zinc and the zinc blast furnace; a thermally ideal zinc-smelting cycle; reoxidation and blue-powder formation; methane as reducer for zinc oxide; and zinc sulphide in smelting. (Includes 130 footnote references.) AHE(31)

Bulldog Slag as Related to Steel. WILLIAM H. STEVENS. *Iron Age*, Vol. 125, May 15, 1930, pages 1457–1458.

Author claims that 99% of slag is used to flux earthy materials out of furnaces. Injurious elements and their compounds enter the metal in the reduction zone in blast furnace. Finished products depend on the influence which C has on oxides, silicates, sulphides, gases and mechanical properties. Correct filling of furnace is necessary, for quality and quantity depend on it. Standard bell distribution gives an ideal filling for American practice, and brings amount of wind required at the tuyères. Large and porous grain structure, heavy cinder and bulldog slag inclusions are also in evidence. Gases following limy furnace pig iron cannot be removed by deoxidizing agents. Corrosion may get its start from this type of pig iron. Hot blast cannot pierce viscous slag. Pig iron resulting is clean, free from scum, fast running and has low graphite content. It meets both chemical and physical requirements. VSP(31)

Charcoal Blast-Furnace Practice in Mysore. B. VISWANTH. *Mining & Metallurgy*, Vol. 11, July 1930, pages 332–335.

Gives details of plant construction and operation of the Mysore Iron Works at Bhadravate, British India. The blast furnace is built of steel plates and lined with fire brick. The hearth is cooled by means of cast Fe plates with wrought Fe cooling pipes cast in them. There are 6 tuyères, and each is surrounded by a Cu cooler. The bosh is thin lined. There are 4 stoves 14 ft. in diameter and 65 ft. 8 in. high. They are of side combustion and two-pass type. Temperature varies from 700 to 1000°F. Charcoal is used as fuel. The principal ore deposit is a mixture of limonite and hematite. Most interesting feature is the peculiarity of the slags. This is probably one of the few furnaces running on high alumina slag. VSP(31)

Sintering of Blast Furnace Dust and Treatment of Carbonate Iron Ores by Greenawalt Method. (Agglomeration des poussieres de hauts fourneaux et traitement des minerais de fer carbonates par le proceded "Greenawalt".) ROBERT CORDONNIER. *Revue de Metallurgie*, Vol. 27, Sept. 1930, pages 467–478.

A description of a sintering installation of Greenawalt design for treatment of carbonate ores of Fe installed at Societe Auxiliaire des Mines des Pyrenees-Orientales at Vernet-les-Bains and the principles involved in its operation. The method eliminates from the core CO_2, H_2O and volatile metals like Zn, As, Sb. Sulphur content is reduced very considerably. JDG(31)

Roasting of Chromite Ores to Produce Chromates. A Study of Effects of Various Reagents and Impurities on Oxidation Reactions. H. A. DOERNER. *Report of Investigations* 2999, June 1930, *United States Bureau of Mines*, 30 pages, 24 references.

When Cr_2O_3 is mixed with excess lime and heated above 800° it reacts to form an insoluble calcium chromite, which is readily oxidized by air to form calcium chromate. This in turn partly decomposes into acid-soluble calcium chromic-chromates of uncertain and perhaps variable composition. The highest conversion to chromate was 75% at 850°. Under similar conditions magnesia reacts to form a brown insoluble chromite, only a small portion of which oxidized to a water-soluble chromate. No acid-soluble decomposition products were found. Over 90% conversion to chromate was obtained by roasting a mixture of equal parts of lime, magnesia and Cr_2O_3 at 850°. Fine grinding, intimate mixing and either wetting or thorough rabbling during the roast are necessary for good results by this method. Roasting 1 part Cr_2O_3, 1.8 parts sodium sulphate and 3 parts lime at 850° gave over 90% conversion to chromate. There was no reaction with Cr_2O_3 and sodium sulphate alone. Dolomite is as effective as limestone. Complete replacement of lime by magnesia gave poor results. Roasting Cr_2O_3 and sodium carbonate gave sodium chromate. Addition of lime promotes the reaction. Practically complete conversion was obtained from a mixture of 2 parts lime, 1.4 parts sodium carbonate and 1 part Cr_2O_3 roasted at 850 to 1070°. Lime can be replaced by dolomite or a mixture of magnesia and Fe_2O_3. Use of the latter required higher temperatures and gave lower conversion. Of the common impurities found in chromite ores, magnesia appears to be beneficial or harmless, alumina has little effect unless alkali salts are absent, and silica is the most objectionable, tending to prevent oxidation of the chrome. AHE(31)

NON-METALLIC COATINGS FOR METALS (32)

Protective Coatings for Iron and Steel. Part II. Paints and Enamels. HENRY N. BASSETT. *Industrial Chemist*, Vol. 6, July 1930, pages 293–297.

The author discusses first the methods of cleaning the surface: (*a*) pickling, (*b*) scruffing, (*c*) sand-blasting, (*d*) use of patent rust removers. He then takes up in some detail the various coatings, discussing the composition and uses of the different enamels, paints, lacquers, enamels with varnish bases, and Japans, as well as the cheaper coatings designed to give partial protection, such as slaked lime in solvent naptha and tallow in trichlorethylene. MPB(32)

Influence of Sea-Water on Paint Coatings. (Einflüsse des Seewassers auf Anstriche.) BÄRENFÜNGER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, March 22, 1930, pages 373–375.

General remarks on damage by corrosion and protective coats. Of all coatings red lead has been shown to be the most satisfactory as it adheres very firmly to iron; care must be taken, however, to use an oil which does not absorb water. The influence of sea water on several paints is shown in photographs, some of them in natural colors. 3 References Ha(32)

Enamelled Hardware. DR. STANLEY SMITH. *Sheet Metal Industries*, Vol. 3, VI, Feb. 1930, page 573; VII, Apr. 1930, pages 297–298.

To achieve the necessary fine coating of ground enamel, it should be diluted with about 40% of water, and so fired that a bend test will not peel off this primary coat. The primary coat should be dried as rapidly as possible. The white enamel coatings should be dried cautiously, preferably in hot air. The average weight of enamel on a piece is 25–30% of the weight of the metal. Burning temperatures and their effect on stannic oxide in the enamel are discussed. Ground enamel burned in at 950–1000° C.; white and blue coating fired at 800–850° C. A short list of rules governing enamelling operations is given. Common enamel defects and their causes are set forth. AWM(32)

Japanning and Enamelling Sheet Metal Ware. "ARGENT." *Sheet Metal Industries*, Vol. 4, June 1930, pages 120–121.

A stove with jets outside the japanning chamber in a flue running around it is recommended. Close thermometer check of temperature is essential to good work. Observing correct time of stoving is absolutely necessary to insure good finish. AWM(32)

Japanning and Enamelling Sheet Metal-ware. II. ARGENT. *Sheet Metal Industries*, Vol. 4, Sept. 1930, page 394.

Freedom from dust in the japanning shop is stressed and means of obtaining this condition are mentioned, i. e., doors and windows doubled, ventilation by means of wall inlets and outlets, white tiled walls, etc. The desirability of a regulated temperature in this room, which should not fall below 65° F., is shown. The preparation of colored japans and the stoving of these is discussed. It is recommended that the preparation of these japans be left to the specialist rather than being attempted by the sheet metal worker. AWM(32)

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Fire Clay Refractories Picture Film

In 1923 under the direction of the United States Bureau of Mines and in coöperation with the Laclede Christy Clay Products Company, a motion picture "Fire Clay Refractories" was produced. It has recently been revised to include improvements that have taken place, such as the modern method of burning refractories by tunnel kilns, and use of improved equipment and machinery. It deals with the manufacture and application of fire clay products, and does so in an interesting and realistic manner that can be appreciated readily by the specialist or the layman.

The film is three reels in length and requires about forty-five minutes to project. It is available in the 35 mm. and 16 mm. sizes for stationary or portable projectors. Copies are distributed by the United States Department of Commerce, Bureau of Mines, Pittsburgh, Pennsylvania, under the motion picture subject No. 97, "Story of Fire Clay Refractories," rental charge free.

◆ ◆ ◆

The **Permold Company** has filed in the United States Federal Court at Cleveland, a suit against the Monarch Aluminum Ware Company for alleged infringement of Letters Patent of the United States No. 1,770,368, granted on the 8th day of July 1930. The Permold Company is asking an injunction and triple damages. It is understood that the suit has to do with metal molds such as are used for the casting of agitators, gyrators and dollies for washing machines.

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Frank H. Adams, General Manager of the Surface Combustion Company of Toledo, Ohio, announces the acquisition of the Gas Equipment Division, including foundry of the Columbus Heating & Ventilating Company of Columbus, Ohio, manufacturers of gas fired warm air furnaces and unit heaters.

The Surface Combustion Company originally specialized in gas fired designed industrial equipment and have made great strides in the automotive, steel and other industries. Recently, this company also acquired the Chapman-Stein Company of Mt. Vernon, Ohio, in order to round out their services in the way of equipment to the steel industry. This was taken over about a year ago, and the Webster Engineering Company of Tulsa, Oklahoma, was taken over about two years ago.

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PATENT DEPARTMENT

An arrangement with Mr. W. M. Corse, Metallurgical Engineer, Washington, D. C., who operates an Engineering Information Service, enables us to publish a list of important patents from the United States, Canada, England, Germany, France, Switzerland, Denmark, Holland, Sweden, Norway and Italy.
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United States Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Note: Numbers of Reissue Patents are preceded by "Re."

Process and mechanism for making metal pellets. D. Martin, 1,780,201, 8/13/28.

Process of producing a two-toned finish on metal surfaces. M. J. Udy, 1,780,-212, 7/28/27.

Method of preparing chromium-plated ferrous articles. V. M. Vertucci, 1,780,-213, 10/7/26.

Lead alloy amenable to hardening by heat treatment. (Pb–Sb–Cd). M. G. Corson, 1,780,261, 6/8/28.

Process of electric flash welding. W. F. Heineman, 1,780,297, 3/26/30.

Utilization of galvanizer's waste. W. G. Waring, 1,780,323, 7/6/29.

Die for flanging sheet metal. J. A. McGregor, 1,780,433, 3/7/28.

Core-molding mechanism. R. E. Dunham, 1,780,470, 1/28/29.

Operating blast furnaces. J. C. Hopkins, & A. Osolin, 1,780,485, 5/13/29.

Molding apparatus. A. T. Bateman, & A. Irvine, 1,780,514, 8/17/28.

Chromium plating. W. M. Phillips, 1,780,535, 6/30/26.

Acid treatment of metal articles. R. E. Lawrence, 1,780,594, 10/9/29.

Inhibitor. R. E. Lawrence, 1,780,595, 10/9/29.

Ingot-stripping mechanism. W. D. Keller & W. L. Poto, 1,780,787, 9/4/28.

Blowtorch support and scriber. R. B. Cregger, 1,780,814, 9/19/29.

Machine for testing and quantitatively indicating the cutting power and durability of blades and cutlery. K. Honda, 1,780,822, 9/18/26; Japan 1/20/26.

Device for treating rough tubes and analogous articles with lead. G. de Dudzeele, 1,780,870, 11/13/28; France 11/16/27.

Conductor. W. B. Ten Eyck, 1,780,953, 3/25/25.

Process for the securing of welds on bended bodies. A. Lützow, 1,780,978, 5/26/27; Germany 5/27/26.

Method of and mold for casting piston rings. E. N. Broderick & T. D. Lucier, 1,781,098, 12/20/26.

Method of cold rolling and coiling strips. H. M. Naugle & A. J. Townsend, 1,781,123, 4/28/27, original 9/23/24.

Method of making castings. J. H. Williams, 1,781,143, 3/7/27.

Mechanism for making molds. E. F. Oyster & F. N. Gilliland, 1,781,126, 8/2/28.

Anode of carbonized iron or the like. L. Smede, 1,781,305, 10/11/27.

Mold for casting ingots of steel or other metals. A. G. E. Hultgren, 1,781,293, 2/11/29; Sweden 2/22/28.

Conveying apparatus for dipping. M. J. Anderson, 1,781,425, 4/9/27.

Means for making double-sided molds. G. Eckstein, 1,781,451, 4/25/29; Germany 4/27/28.

Method of forming alloys. P. A. E. Armstrong, 1,781,490, 5/8/28.

Method of preparing metal for painting. J. H. Gravell, 1,781,507, 10/2/28.

Ferrous alloy. B. D. Saklatwalla, 1,781,527, 10/29/27.

Welding clamping device. L. H. Hoffer, 1,781,548, 9/26/29.

Apparatus for producing bent pipes of correct prescribed lengths. R. H. Böhling, 1,781,567, 4/6/29; Germany 6/14/28.

Process of producing malleable-iron castings. L. H. Marshall, 1,781,119, 4/27/28.

Universal ring-rolling machine. J. H. Taylor, 1,781,140, 12/10/23.

Die-casting machine. E. N. Dollin & C. C. Jacobson, 1,781,168, 2/23/28.

Chromium plating. J. F. K. McCullough & B. W. Gilchrist, 1,781,789, 9/30/27.

Electroplating machine. C. G. Miller, 1,781,791, 12/22/28.

Roll heater. J. D. Williams, 1,781,798, 10/24/28.

Rolling mill. W. F. Detwiler, 1,781,809, 12/14/27.

Electrode holder. P. L. Orr, 1,781,930, 2/12/29.

Multiple-mixture die-casting method and machine. A. Akers, 1,781,939, 8/11/27.

Slug-casting machine. J. A. McGinnis, 1,782,047, 5/27/27.

Articles having tarnish-resisting surface and process of making same. (Cr–Ag). D. Gray, *et al.*, 1,782,092, 5/16/23, renewed 12/13/26.

Testing device. J. L. Theobald, 1,782,127, 10/27/26, renewed 4/25/30.

Method of welding and the resultant product. O. U. Hofmann, 1,782,234, 12/31/28.

Pressure die-casting appliance. K. F. Wagner, 1,782,248, 2/17/28; Germany 2/19/27.

Aluminum alloy. H. C. Hall & T. F. Bradbury, 1,782,300, 10/23/29; England 12/18/28.

Method of welding. B. S. Robinoff, *et al.*, 1,782,316, 5/10/29.

British Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Note: When the date applied for differs from the date on which the application was lodged at the British Patent Office, the former date is given, followed by *.

Production of slags for use in the manufacture of wrought iron. A. M. Byers Co., 315,858, 7/21/28*.

Treatment of complex ores of copper, cobalt and nickel. R. S. Carreras, 336,584, 7/10/29.

Method of separating zinc, tin, lead, bismuth, cadmium, antimony, arsenic and similar elements from sulphide ores or secondary products by means of blast-smelting. E. J. Kohlmeyer, 336,670, 7/19/29.

Molding of liquid or plastic iron, steel and other metals and alloys difficult to mold. P. Multhaupt, 336,688, 7/26/29.

Hydraulic lead cutting-off devices for lead cable presses. F. Krupp Grusonwerk A.G., 336,695, 2/15/29*.

Casting of molten metals or alloys. H. Harris, 336,727, 8/27/29.

Frost protective or thawing agent for protecting metals against the effects of frost. G. Erdbrugger, 336,739, 9/9/29.

Presses for the production of metal cable sheathing and tubes. Felten & Guilleaume Carlswerk A.G., 336,742, 10/22/28*.

Methods of making tungsten and like metal carbides. British Thomson-Houston Co., Ltd., 319,698, 9/26/28*.

Recovering metal values from their ores or from metalliferous materials. Meyer Mineral Separation Co., 336,770, 9/30/29.

Rivets, and methods of manufacturing same. Vereinigte Leichtmetallwerke G. & C. Schwichtenberg, 336,803, 10/21/29.

Power straightening-machines for straightening shafts, bars, and the like. T. Oldfield, 336,843, 11/21/29.

Preserving aluminium from attack by alkalies. G. Adolph, 336,854, 11/29/29.

Method and apparatus for freeing and extracting castings from sand molds. L. A. Camerota, 336,857, 12/5/29.

Alloy, particularly for bearing-surfaces. H. C. Hall, 336,881, 12/30/29.

Annealing-furnaces. W. A. Morton, 336,596, 4/15/29*.

Testing magnetizable bodies. C. Kinsley, 336,987, 6/19/29.

Sheet-metal pipes and the like. A. R. Hutton, 337,020, 6/19/29.

Wire-heating furnaces. H. B. Blythe, 336,947, 6/22/29.

Manufacture of magnetic alloys. W. S. Smith, *et al.*, 336,948, 6/22/29.

Manufacture of iron or steel. H. Hagemann, 336,954, 7/18/29.

Working-up of chromium ores. I. G. Farbenindustrie A.G., 336,970, 7/22/29.

Method of manufacturing hydrocarbon-containing metals and alloys. Bayerische Metallwerke A.G., 316,103, 7/20/28*.

Pleated metal sheeting. M. Meltz, 337,038, 7/25/29.

Light metal alloy. H. T. Tillquist & J. Harden, 337,099, 8/17/29.

Cooling systems for centrifugal apparatus for casting metals. Ferric Engineering Co., 337,105, 8/22/29.

Treating sheet metal by rolling. Baldwins, Ltd. & D. J. Ledwith, 337,114, 8/28/29.

Manufacture of tungsten. A. Pacz, 337,160, 10/3/29.

Method and apparatus for manufacturing lead-headed nails. E. V. Swangren, 337,181, 10/18/29.

Application of varnishes, lacs or like coatings to metal surfaces. Herold A.G., 337,192, 4/30/29*.

Feed mechanisms for presses for operating on metal and other sheets. H. A. Griffiths, 337,230, 11/20/29.

Hot-blast stoves and the like. H. de Gaillard et Cie., 337,254, 2/16/29*.

Casting of metals. I. Sugimura, *et al.*, 337,286, 1/8/30.

Extrusion-presses for the production of rod-like or tubular-shaped bodies. F. Krupp Grusonwerk A.G., 337,300, 3/4/29*; 337,336, 5/31/29*.

Compressed-air plate-holder for double drawing on single-action presses. L. Schuler A.G., 337,312, 4/12/29*.

Manufacture of articles hardened by nitrogenization. F. Krupp A.G., 312, 349 5/25/28*; 337,404, 5/25/28*.

Furnaces or apparatus for the heat-treatment of metals and the like. A. Smallwood & J. Fallon, 337,362, 6/25/29.

Furnaces employing combustion heating and electric heating in combination. International General Electric Co., Inc., 316,229, 7/25/28*.

Chromium or chromium-nickel steel alloys. F. Krupp A.G., 337,349, 6/26/29*.

Production of age-proof welds by the fusion welding method. F. Krupp A.G. 316,555, 7/30/28*.

Method or process of casting stainless steel. W. E. Martin & J. A. Berlyn. 337,413, 7/29/29.

Coated metal bodies and process of producing same. American Rolling Mill Co., 337,399, 7/29/29.

Apparatus for the distillation of volatile metals. E. M. S. Industrial Processes, Ltd., *et al.*, 337,471, 8/3/29.

Mandrel-holders for vertical lead-coating presses for cables. F Krupp Grusonwerk A.G., 337,520, 10/25/28*.

Light metal alloy. Birmingham Aluminium Casting (1903) Co., Ltd., and P. Pritchard, 337,558, 10/9/29.

Protecting iron and steel. A.Folliet & N. Sainderichin, 337,562, 10/10/29.

Electrodes or rods for welding. J. H. Aitchison, *et al.*, 337,589, 10/25/29.

Manufacture of refractory materials from natural magnesium silicates. Metallges. A.G., 337,605, 11/9/28*.

Cementation processes for ferrous metals. A. Folliet & N. Sainderichin, 337,-635, 11/28/29.

Processes for treatment by volatilization of zinc ores and mixtures thereof. A. Folliet & N. Sainderichin, 337,636, 10/19/29.

Process for improving the mechanical properties, especially the compression yield point o farticles made from magnesium and its alloys. I. G Farbenindustrie A.G., 337,706, 3/11/29*.

Production of titanium steel. W. & H. Mathesius, 337,715, 3/16/29*.

Manufacture of stereotype printing plates. Wood Newspaper Machine, Corp., 337,728, 7/1/29.

Manufacture of iron and other metals. Davis Steel Process Corp., 315,760. 7/17/28*.

Production of iron chromium alloys which are stable on heating. Pilzen Skoda Works, 337,767, 4/18/29*.

Apparatus for degreasing materials. Imperial Chemical Industries, Ltd., & F. E. Rogers, 337,770, 8/1/29.

Treatment of lyes from chlorinated burnt pyrites. I. G. Farbenindustrie Akt.-Ges., 337,822, 8/8/29.

Manufacture of cast iron. Meehanite Metal Corp., 337,844, 8/13/29.

Metal extrusion presses. Hydraulik Ges. & O. Schlenstedt, 337,867, 8/24/26.

Alloys and articles made therefrom. R. A. Hadfield, 337,893, 9/11/29.
Steel alloy. Multi-Steel Co., 337,919, 1/24/29*.
Increasing the elongation and bending and rolling capability of sheets, bands, wires and the like consisting of aluminum alloys. Aluminium Industrie Akt.-Ges., 337,922, 10/12/28*.
Electrolytic production of aluminum. Vereinigte Aluminium-Werke Akt., Ges., 337,995, 11/27/28*.
Tilting-gear for crucible furnaces. J. H. Ludlow & Associated Electrical Industries, Ltd., 338,013, 11/25/29.
Welded butt-joints. J. Collinson & Associated Electrical Industries, Ltd. 338,030, 12/12/29.
Rotatable drums applicable for use in cooling materials discharged from rotary furnaces. F. Krupp Grusonwerk Akt.-Ges., 338,069, 1/18/29*.
Manufacture of iron alloys. Vereinigte Stahlwerke Akt.-Ges., 338,071, 1/30/29*.
Manufacture of aluminum by electrolysis. Cie. de Produits Chimiques et Electrometallurgiques Alais, Forges et Camargue, 338,084, 3/15/29.
Method of and apparatus for making sections by bending metal strips between pairs of rolls. J. Kozicz, 338,091, 3/20/29*.
Production of composite metal castings. W. Alberts & F. Stein, 338,092, 8/28/29*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Manufacture of granulated products (from reduction of arsenic-bearing ores). H. C. Gardiner, 305,052, 4/28/30.
Metal painting method. J. H. Gravell, 305,056, 2/10/30; 305,576, 2/21/30.
Sheet metal stretching tool. H. Junkers, 305,068, 12/7/29.
Welded tubing. The Air Reduction Co., Inc., 305,116, 11/27/29.
Welded pipe. The Air Reduction Co., Inc., 305,117, 11/27/29.
Mold core. The Aluminium Ltd., 305,118, 7/31/29.
Molten slag processing (for wrought iron use). The A. M. Byers Co., 305,-138, 6/10/29.
Iron manufacture. The A. M. Byers Co., 305,139–305,142, 6/10/29.
Metal composition (Al–Cd–Cu). The Canadian General Electric Co., Ltd., 305,147, 12/7/28.
Mold treating method. The S. D. Warren Co., 305,237, 10/7/29.
Aluminum casting (Al–Cu–Ti). The Aluminum Co. of America, *et al.*, 305,261, 2/27/28.
Case-hardening metal. P. W. & E. B. Shimer, 305,281, 6/5/28.
Device for casting large accumulator plates. J. A. Fullilove, 305,331, 7/16/29.
Dental filling of high resistance to wear, well polishable and neutral to chemical agents (Cr–Ni with agglutinant). F. Hauptmeyer, 305,336, 12/4/29.
Apparatus for the reduction and recovery of volatilizable metals. W. Job, 305,341, 4/5/27.
Disengaging device on wire drawing benches. C. Rasch, 305,376, 12/4/29.
Production of malleable metal pipes. E. Weir, 305,388, 7/20/28.
Production of malleable metal pipes. E. Weir, 305,389, 5/15/29.
Metal sheet handling mechanism. The American Sheet & Tin Plate Co., 305,404, 1/10/30.
Manufacture of fused refractory metals. The Canadian Westinghouse Co., Ltd., 305,418, 4/4/25.
Method of treating composite wires. The Canadian Westinghouse Co., Ltd., 305,419, 2/9/26.
Method of sintering and fusing refractory metals. Same patentee, 305,425, 9/4/29.
Annealing furnace. The International Nickel Co., Inc., 305,470, 6/26/29; 305,471, 12/12/29.
Bearing metal (Pb–Sn–Na–Li–Al). The S. & T. Metal Co., 305,499, 5/31/29.
Structural steel. Vereinigte Stahlwerke Akt.-Ges., 305,526, 3/6/29.
Process of refining and mixing metals and alloys. G. E. Leavey & T. D. Kelly, 305,530, 2/15/29.
Protection of metals against corrosion (chromium plating). T. E. Murray, 305,533, 7/18/27.
Apparatus for forge welding cylinders, etc. J. Barrow, 305,556, 1/29/30.
Material for preventing metal from corroding. J. H. Gravell, 305,575, 2/21/30.
Metallurgical process for readily oxidizable metals. G. Michel, 305,594, 5/4/27.
Electro-deposition of zinc. U. C. Tainton, 305,614, 5/13/29.
Machine for making tapered tubes. The American Fork & Hoe Co., 305,639, 3/28/29.
Process of protectively treating aluminum and its alloys. The Arthur Arent Laboratories Inc., 305,643, 5/27/29.
Electrolytic recovery of zinc. Electrolytic Zinc Co. of Australasia, Ltd., 305,670, 4/19/27.
Apparatus for roasting or sintering ores. National Processing, Ltd., 305,717, 1/15/29.
Apparatus for reworking finely divided metal particles. The Schmeller Holding Co., 305,726, 1/28/28.
Crucible for manufacturing pipes. La Soc. d'Expansion Technique, 305,732, 4/6/29.
Forming die. The Woodings Forge & Tool Co., 305,743, 1/17/30.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Sheet clamp for draw presses. L. Schuler Akt.-Ges., 694,213, 4/19/30.
Process for reducing metallic compounds. G. N. Kirsebom, 694,283, 4/22/30.
Discharge mechanism for ingot-heating furnaces. Ofenbau G. m. b. H., 694,653, 4/28/30.
Electrolytic process for the recovery of tin in compact form from alkaline liquors Siemens & Halske Akt.-Ges., Addition 37,495 (1st addition to 650,579 filed 3/8/28), 10/7/29.
Process for rendering steel insensitive to the action of hot gases and vapors. F. Krupp Akt.-Ges., Addition 37,502 (1st addition to 626,672 filed 12/23/26), 10/10/29.
Polishing machine, particularly for polishing thin sheets. Berg Heckmann Selve Akt.-Ges., 694,366, 4/24/30.
Molds for casting grooved cylinders. J. Neuville, 694,387, 4/24/30.
Improvements to the electrodes of welding machines. Edward G. Budd Mfg. Co., 694,409, 4/24/30.
Lead pipe. L. Prime, 694,423, 4/25/30.
Cementation pot or the like made of ordinary materials such as cast iron. F. Krupp Akt.-Ges., 694,665, 4/29/30.
Device for compressing the mold material in the production of foundry molds and cores. M. Grindal, Addition 37,501 (1st addition to 682,726 filed 10/3/29), 10/10/29.
Process for forging and swaging a bar of iron or steel. Soc. l'Ebauchage Electrique Procédés Giacchino, Addition 37,520 (1st addition to 682,314 filed 9/26/29), 10/21/29.
Instrument for directly reading the diameter of the impression in the Brinell test. R. G. Guillery, 694,502, 7/31/29.
Electrolysis of zinc. I. G. Farbenindustrie Akt.-Ges., 694,234, 4/19/30.
Assembling electric furnace electrodes. Siemens Planiawerke Akt.-Ges., 694,-428, 4/25/30.
Process for producing metallic sodium and potassium. J. Ylla-Conte, 694,587, 4/26/30.
Shear for cutting rolled material in motion. A. G. Schloemann, 694,799, 5/1/30.
Improvements to alloys of iron, nickel and copper and process for making these alloys. The International Nickel Co., Inc., 694,929 & 694,930, 4/12/30.
New process for heat treating steels and equipment for working it. A. P. Mahoux, 695,045, 8/8/29.
Press for working and shaping sheet metal. Marquette Tool & Mfg. Co., 694,698 & 694,699, 4/30/30.
Electro-pneumatic or electro-hydraulic upsetting machine. C. Strock, 694,898, 5/3/30.
Improvements to processes and machines for working metal, starting with a hollow blank. Bridgeport Brass Co., 694,926, 4/9/30.
Improvements to automatic welding apparatus. Svenska A. B. Gasaccumulator, 694,931, 4/14/30.
Improvements to resistance-heated electric soldering irons. J. M. V. Abeil, 694,968, 5/3/30.
Alloy for protecting iron, steel, copper, etc., against corrosion. Des Torpilles de Saint-Tropex, 695,050, 8/9/29.
Improvements to electric welding machines. J. E. J. Languepin, 695,066, 8/13/29.
Process for making structural iron members which are to be highly stressed. Vereinigte Stahlwerke Akt.-Ges., Addition 37,550 (2nd addition to 565,661 filed 4/30/23), 11/5/29.
Process for treating leucite or aluminous silicates to obtain pure alumina. G. Gallo, 694,885, 5/2/30.
Electrolytic process for producing certain metalloids, metals and alloys. J. L. Andrieux, Addition 37,559 (2nd addition to 638,345 filed 12/1/26), 6/17/29.
Process for making bearings of antifriction alloys. A. E. Ricard, 695,240, 5/6/30.
Rapid process for cementing and hardening fine wire or thin sheet metal. R. Riffaud, 695,398, 5/10/30.
Steel or cast iron having slight tendency to rust. Vereinigte Stahlwerke Akt.-Ges., 695,398, 5/10/30.
Improvements to ingot strippers. E. J. George & C. T. Howland, 695,484, 5/12/30.
Improvements to cupolas and similar furnaces. The British Cast Iron Research Assoc., *et al.*, 695,555, 5/14/30.
Improvements in the extraction and refining of metals. E. Vidal, *et al.*, 695,623, 5/15/30.
Process for forming colored protective layers on the surfaces of aluminum alloy objects. A. Pacz, 695,155, 8/14/29.
Process for joining metal pipes by welding. E. Didier, 695,339, 5/8/30.
Process for making corrugated sheets. H. Syrowy, 695,346, 5/9/30.
Machine for upsetting sheet metal. H. Junkers, Addition 37,613 (2nd addition to 603,544 filed 7/30/25), 11/13/29.
Method and instrument for measuring the hardness of materials. The Shore Instrument & Mfg. Co., 695,533, 5/13/30.
Means for mounting and controlling the electrodes of an electric furnace or electrolytic cell. A. Franchini & P. Girod, 695,216, 8/27/29.
Electroforming process. Metals Protection Corp., 695,360, 5/9/30.
Process for producing alumina. W. J. Muller & H. Hiller, 695,586, 5/14/30.
Improvements to plate shears. E. Fouquet & C. Nageotte, 695,735, 5/16/30.
Rolling process. J. J. G. Sart, 695,656, 9/4/29.
Process for producing aluminum and its alloys. T. R. Haglund, 695,697, 5/15/30.
Aluminum alloy. O. Kamps, 695,838, 5/19/30.
Method of working regenerative furnaces, especially furnaces for melting metals. W. Alberts & P. Zimmermann, 695,850, 5/19/30.
Steel compositions and process of making. Taylor-Wharton Iron & Steel Co., 695,871, 5/20/30.
Feed device, especially for sintering pots. P. Bernhardt, 695,899, 5/20/30.
Machine for making condenser tubes of zinc furnaces, or similar objects. S. A. Metallurgique de Prayon, 696,040, 5/23/30.
Improvements in the production of alloys. Cie Française pour l'Exploitation des Procédés Thomson-Houston, 696,142, 5/27/30.
Process for reducing granular materials containing stannic oxide. "Berzelius" Metallhütten G. m. b. H., 696,146, 5/27/30.
Process for producing volatilizable metals. Metallges. Akt.-Ges., 696,151, 5/27/30.
New arc welding process. Soc. Générale de Constructions Electriques & Mécaniques (Als-Thom), 695,638, 8/20/29.
Process for improving the quality of welds, particularly electric welds. Forges & Ateliers de Construction de Jeumont, 695,662, 9/4/29.
Improved electric welding process and welding rods used therein. A. O. Smith Corp., 695,704, 5/15/30.
Improved process for making coated welding rods for arc welding. A. O. Smith Corp., 695,705, 5/15/30.
Automatic device for moving welding and cutting torches. P. Tesson, 695,818, 5/19/30.
Process for cleaning metallic surfaces. J. H. Gravell, 695,914, 5/21/30.
Improvements to piston molds and method of casting. H. J. Hater, 695,920, 5/21/30.
Improved process for reducing tubing. S. A. d'Escaut & Meuse, 695,934, 5/21/30.
Stamping process. Aluminium Walzwerke Singen Dr. Lauber Neher Co. G. m. b. H., 696,069, 5/24/30.
Electric furnace. Soc des Grand Travaux Electriques, 695,761, 5/16/30.
Process for forming oxidized layers on aluminum and its alloys. R. E. Muller, 696,073, 5/24/30.
Improvements to composite substances, particularly mixtures and alloys. Energy Research Co., 696,206, 5/28/30.

Process for producing magnesium. A. C. Jessup, 696,218, 5/28/30.
Process and means for obtaining refined molten metals from their crude ores. Doherty Research Co., 696,418, 4/2/30.
Improvements to processes and apparatus for heat treating sheet metal. The Duraloy Co., 696,432, 4/18/30.
Process for treating materials containing copper and nickel. The International Nickel Co., Inc., 696,456, 5/8/30.
Process for treating ores containing sulphides. Sulphide Corp., 696,520, 5/22/30.
Rustless cast steel. B. Vervoort, 696,551, 5/28/30.
Furnace for sintering pulverulent ores and metallurgical products. Vereinigte Stahlwerke Akt.-Ges., 696,562, 6/2/30.
Special steel for railroad trackage material, such as rails, etc. P. P. Marthourey, Addition 37,657 (1st addition to 679,357 filed 12/11/28), 11/26/29.
Process for hardening structural steels containing copper. Vereinigte Stahlwerke Akt.-Ges., Addition 37,661 (1st addition to 671,416 filed 3/13/29), 11/26/29.
Centrifugal casting machine. M. Karminski, 696,202, 5/28/29.
Improvements to soldering and brazing torches. S. A. Le Carbone, 696,275, 9/13/29.
Means for backing the roll shafts of pilger mills. E. Rober, 696,409, 2/4/30.
Chain making machine. Mme. Helle, 696,445, 4/30/30.
Reproducing mechanism for torch welding or cutting machines. C. Krebs, 696,499, 5/19/30.
Improved welding machine. Ford Motor Co., Ltd., 696,525, 5/23/30.
Improvements in the electric welding of metal tubing. H. F. McLoughlin, 696,526, 5/24/30.
Fusible electrodes for welding aluminum and its alloys. La Soudure Electrique Autogène, 696,592, 6/3/30.
Tube bending machine. A. J. Galland, 696,628, 6/4/30.
Electric furnace electrode. Soc. Electro-Metallurgique de Saint-Beron, 696,319, 5/30/30.
Thermostat for electric resistance furnaces. S. A. de Commentry, Fourchambault et Decazeville, 696,529, 5/24/30.
Process for coating metal objects with tungsten or molybdenum bronzes. Egyesult Izzolampa Es Villamossagi Reszvenytarsasag, 696,588, 6/3/30.
Improvements to tunnel furnaces. Woodall Duckham (1930), Ltd., 696,563, 6/2/30.
Method and means of using the heat of waste gases from a rotary furnace. Fellner & Ziegler Akt.-Ges., 696,602, 6/3/30.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Rolling-mill cooling device with cooling elements at the rolls. Maschinenfabrik-Akt.-Ges. vorm Ehrhardt & Sehmer, 512,636, 8/16/29.
Roller bed with individual electric drive for the rollers. Fried. Krupp Grusonwerk Akt.-Ges., 512,123, 5/30/29.
Multiple wire-drawing machine. W. Nacken, 512,216 (Addition to 511,090), 4/14/28.
Method of rolling. Vereinigte Stahlwerke Akt.-Ges., 512,217, 7/19/29.
Draw-press. The Hamilton Press & Machinery, 512,124, 12/9/28.
Safety-lock for clutch bars, particularly for sheet metal working machines. M. Lang, 512,557, 8/9/29.
Device for feeding material to eccentric presses. H. Spörl, 512,126, 9/3/29.
Process for making profiled rings (tire rims). Budd Wheel Co., 512,558, 3/16/28; U. S. 3/15/27.
Machine for rolling pre-formed steel balls. J. Maier, 512,127, 2/23/28.
Process for decomposing aluminiferous materials, particularly bauxite, with reducing agents and pyrites. Vereinigte Aluminium-Werke Akt.-Ges., 512,564, 12/25/29.
Device for blowing gas into the tuyères of blast furnaces. Fried. Krupp Akt.-Ges., Friedrich-Alfred-Hütte, 512,574, 1/20/29.
Process for making high-test gray cast iron. Vereinigte Stahlwerke Akt.-Ges. and K. Emmel, 512,391, 12/10/24.
Mandrel to be inserted in molten metal in a crucible for the purpose of preventing formation of stresses on reheating. T. Metzger, 512,338, 12/9/28.
Method of working a conveying and discharge device for industrial furnaces. Benno Schilde Maschinenbau-Akt.-Ges., 512,491, 5/11/28; U. S. 12/8/27.
Process for making electric heating resistances by molding and firing a mixture of coal and metallic oxides. Electroterm Akt.-Ges., 512,264 (Addition to 481,796), 1/23/30.
Process for replenishing self-baking electric furnace electrodes. Siemens-Planiawerke Akt.-Ges. für Kohlefabrikate, 512,499, 1/22/27.
Device for arc welding, using a protective medium which is not gaseous at ordinary temperature. Siemens-Schuckertwerke Akt.-Ges., 512,500, 8/18/27.
Method and machine for charging sand into molds. H. Weber & K. Grocholl 512,269, 10/6/28.
Process for filling holes in metallic objects, particularly castings. Metallisator Berlin Akt.-Ges., 512,347, 2/21/30.
Machine for ejecting pipes from molds. S. A. des Hauts Fourneaux et Fonderies de Pont-à-Mousson, 512,348, 9/12/29, France 4/27/28.
Process for sintering dusty ores and metallurgical products in a shaft furnace, Vereinigte Stahlwerke Akt.-Ges., 512,171, 11/10/29.
Electrode plate for leading the current into anode material in lump form. Imperial Chemical Industries, Ltd., 512,277, 1/20/29; Great Britain 2/25/28.
Anode arrangement for the electrolytic refining of noble metals. Siemens & Halske Akt.-Ges., 512,172, 5/15/28.
Method of transferring heated material from a closed heating container into a cooling container which is movable relative to it. Akt.-Ges. Brown, Boveri & Cie., 512,173, 12/2/25.
Mill for rolling sections. F. Möller, 513,122, 1/3/30.
Machine for attaching fins to wrought iron tubing. Z. Rodakowski, 512,713, 8/2/29.
Damper for gas-fired furnaces, particularly blast heaters. Zimmermann & Jansen G. m. b. H., 513,109, 11/29/28.
Process for the direct production of metals, particularly iron. Allgemeine Elektricitäts Ges., 513,110, 9/22/26.
Ferrous alloy containing chromium and aluminum and process for heat treating the same to develop high permeability. W. H. Smith, *et al.*, 512,727, 4/29/28; Great Britain 4/20/27.
Process for annealing sheets in a vertical position in annealing boxes. R. Eickworth, 512,888, 12/22/26.
Ironless high-frequency furnace. Heraeus-Vacuumschmelze Akt.-Ges. 512,819, 8/9/27.
Process for soldering butt joints in copper cables. C. Cremer, 512,701, 11/26/26.
Machine for electrically welding thick-walled tubing. A. Pretzschner G. m. b. H., 513,135, 1/1/29.
Machine for welding tie plates to iron ties. Siemens-Schuckertwerke Akt.-Ges., 512,653 (addition to 507,150), 12/16/26.
Method of connecting arc-welding transformers. E. Schröder, 512,978, 6/2/28.
Jolt molding machine. Tabor Mfg. Co., 513,140 (Addition to 510,493), 5/4/29; U. S. 7/2/29.
Roller drive for centrifugal casting machines. W. H., Beatty, *et al.*, 513,141, 12/8/28.
Process for casting reinforced bearings. Eisen- & Stahlwerk Walter Peyinghaus, 513,053, 2/19/27.
Production of low-silicon, carbon-free metals and alloys, particularly manganese. J. Debuigne, 513,112, 9/1/23.
Recovery of copper from the lixivia of chloridizing-roasted pyrites. Reymersholm Gamla Industri A.B., 513,149, 10/3/26; Sweden 9/20/26.
Detinning tin-coated metal. P. Marth, 512,749, 10/18/28.
Chemically-resistant objects made of silver alloys. I. G Farbenindustrie Akt.-Ges., 512,986, 6/20/26.
Utilization of aluminum alloys containing magnesium and titanium. R. Müller, 513,016, 9/19/26.
Non-conducting border for cathodes used in electrodeposition of metals. Metallges. Akt.-Ges., 512,913, 11/8/27.
Increasing the electrical conductivity of commercial aluminum. Siemens & Halske Akt.-Ges., 513,017, 8/22/26.
Torsion machine, particularly for testing. A. J. Amsler, 512,915, 4/17/29.
Charge-supporting bars for muffle furnaces. Metall-Industrie J. Klefisch, 512,992, 4/23/29.
Muffle-furnace bottom. Same patentee, 512,993, 4/27/29.
Rolling mill. R. Kronenberg, 513,283 (Addition to 449,011), 6/21/29.
Pinion housing for three-high mills with frictionally-driven middle roll. F. Grah, 513,523, 2/27/30.
Mechanism for turning rolled material. J. P. Kieffer, 513,524, 1/3/30.
Arrangement of the dies of multiple wire-drawing machines. W. Nacken, 513,459, 9/14/29.
Tool for attaching helical ribs to a pipe. J. O. Huse, *et al.*, 513,460, 7/29/27; U. S. 8/6/26.
Process for producing pure iron. I. G. Farbenindustrie Akt.-Ges., 513,362, (Addition to 493,778), 1/14/28.
Modification of the apparatus for hardening the heads of rails to permit simultaneous hardening of several rails. Eisenwerk-Ges. Maximilianshütte, 513,212 (Addition to 503,369), 1/8/28.
Method of preventing penetration of carbon into parts of metallic objects during Case hardening. Vereinigte Schweiss- & Apparatebau-Werke G. m. b. H., 513,465, 7/25/29.
Process for making self-baking electrodes. Det Norske A/S for Elektrokemisk Industri, 513,226, 3/16/26; Norway 4/7/26.
Sand-projecting molding machine. W. Seidemann, 513,378, 8/31/29.
Sand-preparing machine. Badische Maschinenfabrik & Eisengiesserei 513,516, 10/25/28.
Mechanical purification of metals and non-metallic ingredients. Braunschweiger Hüttenwerk G. m. b. H., 513,273, 7/3/26.
Cell for electrolytic separation of metals. I. G. Farbenindustrie Akt.-Ges. 513,188, 2/22/27.
Process for cleaning metallic surfaces, particularly for the removal of oxide layers. J. Janz, 513,454, 5/25/28.
Soldered joint. Victoria-Werke Akt.-Ges., 513,406, 11/2/28.

Norwegian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for making sections with uniform wall thickness by die-pressing. I. G. Farbenindustrie Akt.-Ges., 48,566, 8/22/29.
Chill mold. J. Züblin, 48,577, 9/21/27.
Centrifugal process and machine for making or lining pipes and the like. Hume Steel, Ltd. 48,591, 2/2/29.
Process for roasting pyrites. M. Abel, 48,606, 5/8/29.

Swedish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Method of operating electric annealing furnaces. Akt.-Ges. Brown, Boveri & Cie., 70,696, 6/22/27, Priority 6/23/26.
Process for making carbon electrodes which are protected against burning in air, I. G. Farbenindustrie Akt.-Ges., 70,844, 11/27/28, priority 12/23/27.

Swiss Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for making a rust-preventive and acid-proof paint for metals and the like. W. Seeger, 141,887, 8/22/28; Germany 8/22/27.
Process for coating iron or steel objects. Soc. Continentale Parker, 141,898, 12/17/28.
Process and machine for making electrically-welded tubing. F. Sönnichsen *et al.*, 141,938, 7/4/29; Norway 8/11/28.
Hot-rollable bimetals and process for making the same. Metallges. Akt.-Ges. 141,943, 7/31/29.
Furnace for annealing metals under a protective hood. Siemens-Schuckertwerke Akt.-Ges., 141,944, 7/15/29; Germany 5/1/29.
Electric annealing furnace. Akt.-Ges. Brown, Boveri & Cie., 142,004, 9/17/24; Germany 9/24/28.
Electrically-conducting coating and process for making the same. Einstein's Electrochemical Process, Ltd., 142,176, 2/28/29.
Process for making copper-bearing cast iron or steel. F. Heusler, 142,213, 8/8/29; Germany 8/20/28.
Aluminum alloy. Metallges. Akt.-Ges., 142,214, 11/6/29; Germany 12/7/28.
Process and apparatus for melting easily fusible metals. C. Brackelsberg, 142,215, 11/1/29; Germany 8/20/29.
Process for making a flux for aluminum. W. Reuss, 142,216, 6/4/28; Germany 2/15/28.
Electric brazing and welding torch. G. Ruthardt, 142,217, 9/20/29.
Process for coating metals with aluminum or aluminum alloys. Vereinigte Silberhammerwerke Hetzel & Co., 142,221, 9/20/29; Germany 10/3/28.
Continuous furnace for annealing strip wire and the like. Siemens-Schuckertwerke Akt.-Ges., 142,222, 10/21/29; Germany 1/30/29.

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

1 **"Shear Cut" Hobs.**—The engineers of the Illinois Tool Works have designed a hob with a shearing action which gives the same production advantages that a spiral gash or shear gives a milling cutter. Due to this shearing action it has been termed the "Shear Cut" Hob. General reconstruction as to the sizes of hobs, etc., are set forth in a leaflet published by the Illinois Tool Works, 2501 N. Keeler Ave., Chicago, Ill.

2 **Steel.**—The P. F. McDonald & Co., 17 King Terminal, Boston, Mass., have recently issued a leaflet which lists the various steels manufactured by them. Special attention is paid to their die, chisel and tool steels. Suggestions for heat treatment of these are given.

3 **Die Steel.**—Vanadium-Carbon-Die-Steel, VanDieCar, is fully described in a new folder sent out by the Ziv Steel & Wire Co., 2945 W. Harrison St., Chicago, Ill. The method for hardening and drawing this steel is given.

4 **Facts for Foundrymen.**—This convenient 48-page booklet is intended as a foundryman's handbook giving a useful description of various metals and alloys that may assist in the production of more perfect castings. Niagara Falls Smelting & Refining Corp., 2204 Elmwood Ave., Buffalo, N. Y.

5 **Drilling Manganese Steel.**—The Hercules Major Drill has proven itself pre-eminent in the field of manganese steel drilling. A leaflet published by Whitman & Barnes, Inc., Detroit, Mich., tells how to drill high manganese steel using Hercules Major drills. A list giving specifications for these drills is included. Another leaflet issued by the same company describes their Blue Diamond High Speed Drills.

6 **Speed Regulator.**—Catalog No. D-88 gives detailed information about the Reeves transmission and describes its applications in scores of industries. It will be convenient for reference on any problems involving accurate regulation. Reeves-Bond Sales Co., 39 S. Clinton St., Chicago, Ill.

7 **Alloy Steels in the Railroad Field.**—An interesting article with the above title written by Charles McKnight was presented before the A.S.M.E. and is reprinted by the International Nickel Co., Inc., 67 Wall St. New York, N. Y.

8 **Airplane Pulleys.**—Micarta control-wire pulleys for airplanes are discussed and described in a new publication, identified as D.M.F. 5300-A. issued by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. This publication contains tabulations showing the style numbers, dimensions and list prices of the pulleys, and includes photographs and drawings of them.

9 **Reducing Furnaces.**—Ability of Strong, Carlisle & Hammond Engineers to meet the requirements of any industrial furnace user is well demonstrated in a new installation of two SC & H gas-fired furnaces used in the reduction of certain metals. These are described in a leaflet issued by the Strong, Carlisle & Hammond Co., Cleveland, Ohio.

10 **Condensate Pumps.**—Westinghouse single-stage condensate pumps have been developed to meet the demand for efficient reliable units with low installation and operating costs. Each pump is so designed that ready access may be had to all interior parts, and all parts that are subject to wear are easily renewed. These are fully described and illustrated in a folder sent out by the Westinghouse Electric Mfg. Co., Philadelphia Works, Philadelphia.

11 **Carburizing Containers.**—For the past 10 years the Driver-Harris Co. have been experimenting with "Nichrome" Sheet, in the form of carburizing containers and they are now in an advantageous position to meet the recent increased demand for sheet containers. They have compiled a brochure showing "Nichrome" sheet, cast "Nichrome" and other "Nichrome" installations. Driver-Harris Co., Harrison, N. J.

12 **Manganese Steel Equipment.**—A great variety of equipment parts manufactured by the American Manganese Steel Co., Chicago Heights, Ill. are illustrated in a folder recently sent out by the company. These are more fully described in the Amsco Catalog, which can be obtained from the company. In the October 1st issue of the Amsco bulletin there are interesting illustrations of oil well equipment in which Amsco sheaves are used.

13 **Acid Proof Pipe.**—A bulletin distributed by the American Manganese Steel Co., St. Louis, contains test reports of its acid-resisting pipe. This material can be economically used in various ways.

14 **Nonferrous Ingot Metals.**—A booklet sent out by the Tottenville Copper Co., Inc., New York, gives a list of the various standard formula ingots this company produces. Their chemical and physical properties, and applications are also given.

15 **Steel Castings.**—Transportation units acquire a high degree of safety from steel castings manufactured by the Lebanon Steel Foundry, Lebanon, Pa. according to a bulletin recently issued by the company.

16 **Protective Coatings.**—Two bulletins sent out recently by the Headley Emulsified Products Co., Philadelphia, describe its waterproofing compounds and its asphalt-base aluminum coating.

17 **Sheet Steels.**—The special sheet steels manufactured by the Superior Sheet Steel Co., Canton, Ohio, are put to varied uses. These are illustrated in a recent bulletin issued by the company.

18 **Electric Steel.**—Steels produced in an induction furnace are discussed in detail in a bulletin of the Heppenstall Co. of Pittsburgh, Pa.

19 **Steel Castings.**—Great care is used in the foundry of the Industrial Steel Casting Co. of Toledo, Ohio, to produce castings of high grade. The advantage of steel castings is discussed in their current bulletin.

20 **Steel Deoxidizer.**—The Vanadium Corp. of America, New York, manufactures a steel deoxidizer containing aluminum, silicon and iron. Its advantages and uses are described in a recent bulletin sent out by the company.

21 **Wire Tables.**—Useful tables showing the breaking strength of various types of copperwelded wire have been published by the Copperweld Steel Co., Glassport, Pa.

22 **Arc Welding.**—This booklet sent out by the Lincoln Electric Co., Cleveland, Ohio, gives much detailed information on the advantages of arc welding. It gives the results of tests conducted in the laboratory of the company.

23 **Heat Treatment.**—This attractive 75-page booklet discusses the heat treatment of steel, and after telling how electric heat treatment affects production costs it describes a number of standard electric furnaces manufactured by the General Electric Co., Schenectady, New York. Another small pamphlet (GEC 93) issued by the same company describes their welding electrodes. Several new leaflets describing the G. E. Conveyor Furnace, G. E. Air-Draw Furnace and Direct-Heat Electric Furnace have been sent out by this company. These last are for filing in the G. E. binder.

24 **Forging.**—A paper "Nickel-Alloy Steel Forging" by Charles McKnight, which was presented before the A.S.S.T., has been reprinted in the new leaflet published by the International Nickel Company, 67 Wall St., New York. This is punched for filing in their binder "Nickel Steel." This company has also collected a number of leaflets which they put together under the title: "Nickel Cast Iron." These are mostly reprints of articles pertaining to this subject which have appeared recently, with the addition of some original articles by members of the company. An interesting booklet gotten out by the same company is entitled: "The Use of Nickel in Non-Ferrous Castings." The data for this has been collected by the research department of the company.

25 **Alloy Steel.**—"Miraculoy," a new alloy having unusual tensile strength and hardness is discussed in a folder issued by the Sivyer Steel Casting Company, 37th Ave., and Mitchell St., Milwaukee, Wis.

26 **Pyrometers.**—Electrical pyrometers and thermometers for measuring all temperatures between −2500 and + 3000° C. or −4200 and +5500° F. are described in Bulletin 10 published by the Thwing Instrument Company, 3339-41 Lancaster Avenue, Philadelphia, Pa. The 3 general types, thermocouple pyrometers, radiation pyrometers and resistance thermometer. are taken up.

27 **Temperature Control.**—Catalog L 3 published by the Wilson Maeulen Company, 383 Concord Avenue, New York, discusses in detail pyrometers of recording, indicating and automatic control types. The catalog is fully illustrated.

28 **Metal Cleaning.**—Antoxylin is a new chemical fluid for use in preparing metals prior to the application of all kinds of primers, paints, lacquers, etc. This preparation removes the impurities from the surface of the steel and then forms a film which excludes all air, moisture, etc., leaving the surface ready for finishing. Bulletin No. A, issued by the Antoxylin Chemical Corporation, 42 Broadway, New York City.

29 **99.99 + % Zinc.**—This very interesting booklet issued by the St. Joseph Lead Company, 250 Park Avenue, New York, contains much detailed information about "Bunker Hill" 99.99+% zinc, for use in die-castings. Mr. Sam Tour, metallurgist, well known in the die-casting industry, has made experiments and reports which are included in this pamphlet.

30 **The Scovill Standard.**—The October issue of this magazine published by the Scovill Manufacturing Company, Waterbury, Connecticut, contains an interesting article on Air Transportation, in addition to an article on Light, Heat and Power, a discussion of public utilities.

31 **"Kromepatch."**—A 4-page folder compares this chrome ore base cement with other cements for use in furnace linings. This is distributed by the E. J. Lavino Company, Bullitt Building, Philadelphia.

32 **Set Screws.**—The Bristol Company, Waterbury, furnish set screws with 6 different styles of points, designed to perform various classes of setting work. These different styles are illustrated and the prices of the different sizes tabulated in a leaflet issued by this company.

33 **Carburizing Compound.**—The J. W. Kelly Co. of Cleveland, Ohio has recently taken over the distribution of the Beacon Brand products. Their carburizing compound, cleaners and oils for several uses are described in a booklet entitled: "Beacon Brand and the Industry," published by the J. W. Kelley Co.

34 **Rust Prevention.**—Several leaflets published by the Dearborn Chemical Company, 310 S. Michigan Avenue, Chicago, Ill., describe the use of No-OX-ID, in various ways. Another leaflet by the same company describes the use of Dearborn Cleaner in powder form.

35 **Control Pyrometer.**—Republic Control Pyrometer eliminates all metallic contacts, replacing them with a gas-filled mercury-switch. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.

36 **Shakeproof Lock Washer.**—4-page broadside which describes and illustrates a lock washer manufactured by the Shakeproof Lock Washer Company, 2501 North Keeler Avenue, Chicago, Ill.

37 **Steel Stamina.**—The summer issue of this publication contains an article on nitriding, and data comparing the 4 commercial methods of obtaining hardness values. Lindberg Steel Treating Co., 222-226 Union Park Court, Chicago, Ill.

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Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS

These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

GENERAL (0)

Trends in Cast Alloy Steels. Staff article—interview with A. W. LORENZ (Bucyrus-Erie Co.), & DAVID C. ZUEGE, (Sivyer Steel Casting Co.) *Product Engineering*, Vol. 1, Dec. 1930, pages 560–561.

Total output of alloy steel castings is analyzed. Properties imparted by Mn, Cr, Ni, Mo, V, singly and in principal modern combinations, are summarized. MFB(0)

Principles of the Shaping and Annealing of Metals. (Stoffliche Grundlagen der spanlosen Verformung und Glühbehandlung von Metallen.) G. SACHS. *Metallwirtschaft*, Vol. 9, March 14, 1930, pages 238–242.

6 references. A review of cold and hot working, power, requirements, drawing, extruding, effect of residual strains due to working, heat treatment and recrystallization. CEM(0)

Evaluation of Raw Materials for the Iron and Steel Industry. ALFONS WAGNER. *Foundry Trade Journal*, Vol. 43, July 10, 1930, page 27.

Abstract translation of article in *Stahl und Eisen*. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 688. VSP(0)

Apprenticeship, the Need of the Metal Trades. HAROLD S. FALK (Falk Corporation). *Machinery*, Vol. 36, June 1930, pages 771–774.

Discusses the lack of apprentice training in the industries and the possibility of development of such training. The writer believes that apprentice training is essential to the building of a strong personnel in the metal trades and to the growth and development of the industry. RHP(0)

Nickel Alloy Steel Forgings. CHARLES MCKNIGHT (International Nickel). *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 129–146.

Paper presented before the Semi-Annual meeting in New York February 7 and 8, 1930. Includes discussion. The author brings together the results of the experience of several manufacturers of large forgings of nickel and nickel alloy steels discussing their manufacture, effect of alloys, analyses used, heat treatment, properties and inspection. The discussion includes the machinability of such forgings. WLC(0)

PROPERTIES OF METALS (1)

Lithium—The Lightest Metal. H. S. SPENCE. *Canadian Mining Journal*, Vol. 51, Oct. 24, 1930, page 994.

An outline of the present stiuation regarding lithium ores in Canada. The Silver Leaf Mining Co. has opened a property about 10 miles northeast of Pointe-du-bois, where the principal minerals found are: lepidolite, spodumene, and montebrasie (a variety of amblygonite). WHB(1)

Beryllium as a Possible Structural Metal. C. B. SAWYER. *Journal Society Automotive Engineers*, Vol. 26, Jan. 1930, page 98.

Beryllium has the following peculiar combination of properties which justify the most serious engineering attention: very low density; high strength comparable to that of steel. Its one serious fault as a structural metal is that it lacks ductility. The composition of beryl is such that it resembles clay with part of its aluminum oxide replaced by beryllium oxide. (1)

The Magnetic Characteristics of Nickel. F. TYLER. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 9, May 1930, pages 1026–1038.

Quantum and classical theory curves for the variation of the spontaneous magnetization with temperature below the Curie point are obtained and compared with the experimental results for nickel. Curves corresponding to large external fields are also considered. There seem to be irregularities in the variation in magnetization close to the Curie point. Discusses magnetic data for temperatures above the Curie point. Presents a possible explanation of the magnetic characteristics. There are several objections to this explanation, however, no definite conclusions can be drawn until the relation between conduction electrons and interaction electrons is more fully worked out. RHP(1)

A Note on Metallic Magnesium. W. R. D. JONES. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 237–240.

See *Metals & Alloys*, Vol. 1, Aug. 1930, page 688. (1)

Experiments on the Apparent Deviation from Ohm's Law for Metals at High Current Densities. H. MONTEAGLE BARLOW. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 9, May 1930, pages 1041–1055.

Several investigations have been made in this field all of which, except one by Bridgman indicate that very slight, if any deviations exist. Bridgman claims to have observed and measured a definite increase in the effective resistance of gold and silver films to currents of the order 10^6 amp/cm^2. Gives briefly Bridgman's methods and results. The author uses the same methods but with certain refinements to obtain a higher degree of accuracy. His methods are outlined and results given. The conclusions drawn seem to indicate that Bridgman secured some erroneous results and that Ohm's law holds for relatively high current densities. RHP(1)

The Fatigue of Metals—A Review of Progress from 1929 to 1930. H. F. MOORE. *American Metal Market*, Vol. 36, Nov. 6, 1930, pages 11-12.

See *Metals & Alloys*, Vol. 1, Jan. 1930, page 336. WHB(1)

The Properties of Pure Nickel. LOUIS JORDAN & WILLIAM H. SWANGER. *Bureau of Standards Journal of Research*, Vol. 5, Dec. 1930, pages 1291–1307.

Rather pure electrolytic nickel was further purified by annealing in hydrogen. A study was made of suitable refractory crucibles and of melting conditions to produce extremely pure compact metal. The ingots finally prepared were of a purity of 99.94%. New determinations of many of the physical properties of nickel have been made on the very pure metal thus made available. Data are given on density, crystal-lattice constant, melting point, electrical resistivity, magnetic properties, thermal e. m. f., thermal expansion, hardness, tensile strength and reflectivity. (1)

The Purification of Manganese by Distillation. JAMES B. FRIAUF (Carnegie Institute of Technology). *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 213–219.

Includes 9 references. Describes the induction furnace set up for the purification of metallic manganese under vacuum. Analysis showed carbon 0.004%, and silicon 0.002% with the spectroscope showing no iron and only traces of aluminum. WLC(1)

Aluminum, the Light Metals and Their Alloys. (Aluminium, Die Leichtmetalle und ihre Legierungen.) PAUL MELCHIOR. (AEG-Berlin). *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 13, 1930, pages 1267–1272.

The properties of the technical "light-metals," i. e., aluminum, magnesium and their alloys with other metals have been collected and tabulated in the "Aluminum Book" of the author. The most important properties for the designer are given, electric and thermal constants of the light rolling metals and cast alloys, tensile strength as function of the chemical composition and pre-treatment, admissible stresses and constructive utilization of the low specific gravity. Most of these properties depend on the purity of the metal and kind of alloy. Rolling metals are: (1) Pure aluminum; (2) Refined Al-alloys of high tensile strength; (3) Refined Al-alloys of high electric conductivity; (4) Aluminum alloys of especially high resistance against corrosion; (5) Electric. Cast alloys are: (*a*) aluminum alloys with additions mainly of Cu, Zn, Si; (*b*) refinable Al-cast alloys; (*c*) electron. Numerical figures of most of the before-mentioned properties are given and tabulated, and fields of applications named. All light-metals, even if containing iron in comparatively high amounts, are non-magnetizable. Ha(1)

The Influencing of Intensities in the Mercury Spectrum. (Zur Beeinflussung der Intensitäten in Quecksilberspektrum.) ERNST LUEBCKE. *Wissenschaftliche Veröffentlichungen aus dem Siemenskonzern*, Vol. 9, No. 2 (1930) pages 246–251.

If in a vacuum mercury arc the cathode space is cooled a change in color of the emitted light can be observed due to a strengthening of the initial single terms and a weakening of the initial triplette terms. The distribution of potential and temperature of room and electrons measured at the same time permits the conclusion that this optical phenomenon is caused by the increased velocity of the not-ordered electrons. Ha(1)

The Freezing Point of Nickel as a Fixed Point on the International Temperature Scale. H. T. WENSEL & WILLIAM F. ROESER. *Bureau of Standards Journal of Research*, Vol. 5, Dec. 1930, pages 1309–1318.

The freezing point of nickel was determined by measuring with an optical pyrometer the ratio of brightness of red light of wave length 0.6533 μ emitted by black bodies at the freezing points of nickel and gold, respectively. The nickel was frozen in magnesia crucibles *in vacuo*. The freezing point was found to be 1455° C. on the International Temperature Scale with an uncertainty of 1°, based on the value 1063° C. for the freezing point of gold and 1,432 cm. deg. for C_2. The temperature coefficient of resistance of the two separate ingots of nickel used was approximately 0.0067 in the interval 0° to 100° C. The chemical analyses indicated the purity of the nickel as 99.94%. The importance of the nickel point in optical pyrometry is discussed. The freezing point of pure nickel in magnesia crucibles was found to be very satisfactory as a fixed point in accurately extending the high-temperature scale beyond the platinum point. (1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Elastic and Tensile Characteristics of Some Light Alloys. (Caratteristiche di elasticità e resistenza di alcune leghe leggere.) G. COLONNETTI & G. M. PUGNO (Royal School of Engineering, Turin.) *La Metallurgia Italiana*, Vol. 22, Nov. 1930, pages 963–975.

The modulus of elasticity was determined on a 150 mm. (6″) test length for Lautal with an Ewing extensometer, and on the other alloys on a 50 mm. (2″) test length with a Martens extensometer reading to 0.0001 mm. The detailed figures for every reading are given, as well as plotted in curves. The stress-strain diagrams for Lautal were only slightly curved, but those for Avional and Anticorodal were noticeably curved. There is, therefore, a marked difference between the average moduli determined over the full range and over a small range of loading. In all tests there was a considerable hysteresis loop between the loading and unloading curves. Conclusions are are drawn as to the force of restitution compared to that of deformation. It is thought by the authors that the thermo-dynamic causes for the phenomena should be sought by profound further study. Since the illustrations show that the bars were held in ordinary wedge grips and apparently no duplicate bars were tested, it is a question whether the data are really as precise as the authors believe. Their summarized data follow:

No.	Name	Composition Al	Cu	Si	Mn	Mg	Condition	Tensile Properties Elas. Lmt. lbs./in.²	Ten. Str. lbs./in.²	Avg. Mod. Elas. lb./in.²	Elong. %	Red. Area %	90° bends over 7.5 mm. (0.3″) radius
1	Lautal VLW 11½	94	4	2	...	...	As drawn	35000	39000	9,650,000	8	48	..
2	Lautal VLW 12	do	do	do	...	...	Annealed 350° C., slow cooled	25300	25800	10,590,000	20	30	..
3	Lautal VLW 13	do	do	do	...	...	Water quenched from 500° C.	36000	49300	10,080,000	20	44	..
4	Lautal VLW 14	do	do	do	...	...	As No. 3, aged at 125° C. in oil 20 hrs.	34000	55700	10,390,000	20	40	..
5	Avional D	94.5	4	0.5	0.5	0.5	As rolled	39900	58300	(a) 10,670,000			
										(b) 11,800,000	17	..	4
6	Anticorodal A	97.8	..	1	0.6	0.6	Half-hard	19900	35600	(a) 9,900,000			
										(b) 10,530,000	18	..	9
7	Anticorodal B	do	..	do	do	do	Hard	38400	44800	(a) 10,200,000			
										(b) 8,800,000	15	..	6
8	Anticorodal H	do	..	do	do	do	Homogenized	21300	31300	(a) 9,650,000			
										(b) 9,820,000	19	..	11

(a) Full range of loading
(b) Loaded to 10,000 lbs./in.² only

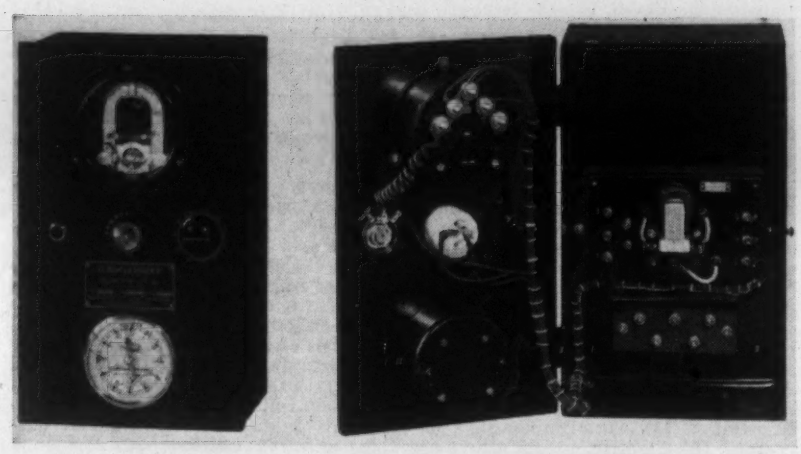
Nos. 1–4 Drawn to 20 mm. (0.8″) diam.
Nos. 5–8 Rolled to 1.5 mm. (0.06″)

HWG(2)

New Products

Automatic Excess Temperature Cutout

The automatic excess temperature cutout of the Hevi Duty Electric Company can be applied to any type of furnace to guard the work or furnace from damage due to overheating.



It has been the practice to employ an excess temperature fuse or link in the furnace control system which was intended to melt in case the furnace exceeded safe temperatures. The shortcomings of this method brought about the development of the automatic excess temperature cutout.

The instrument responds to a thermocouple located in the furnace chamber which actuates a thermal cutout to control a relay which is a part of the furnace control system. Adjustable controls are provided so that the instrument can be set for any desired temperature. It can be calibrated for any thermocouple and used for protection purposes up to 3000° F. In case the furnace temperature rises to the set point, contact is made and the heating source interrupted. Warning is provided also, against failure of the thermocouple operating this instrument.

When the relay is actuated, the heating source is shut off, and a light indicates or an alarm bell may be rung to attract the attention of the operator.

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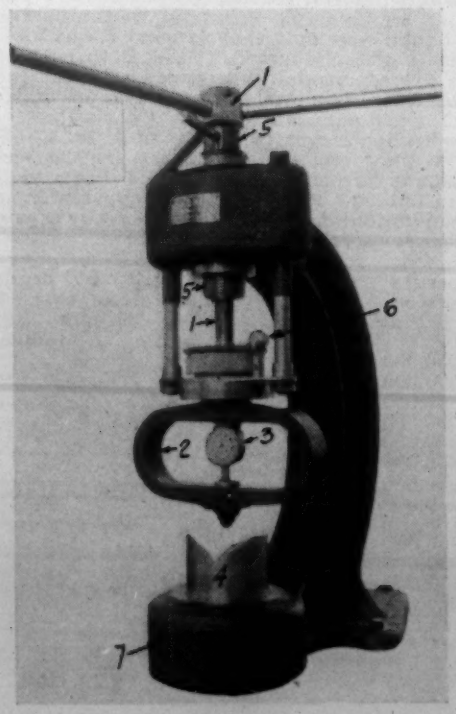
Wazau Brinell Hardness Tester

In the Wazau hardness tester the load is applied by a hand-driven screw (1) and measured by an elastic precision ring dynamometer (2) and dial (3) which is graduated in 10 kg. divisions. Three revolutions of the pointer represent 3000 kg.

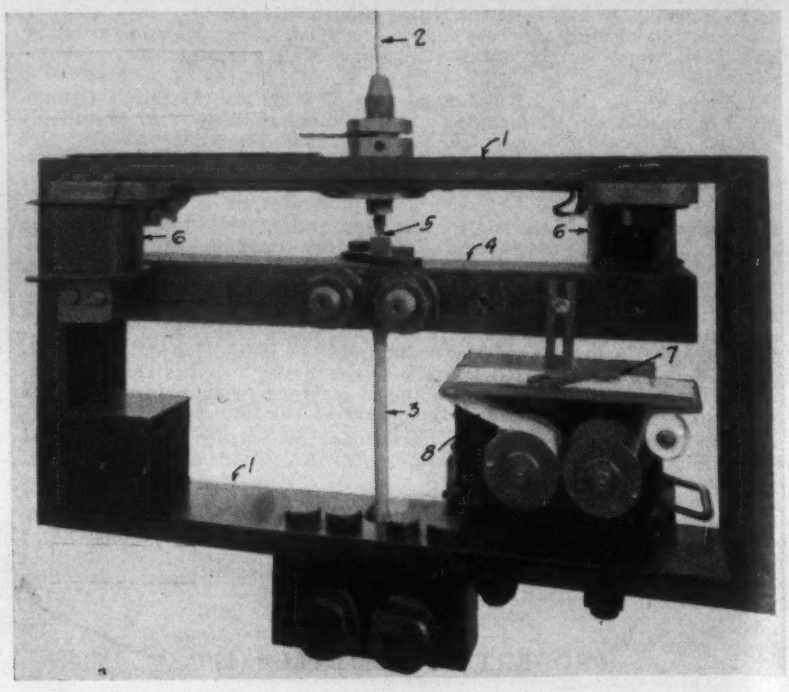
The vertical opening of the press is 4″ and can be quickly adjusted to any smaller distance by inserting blocks (4) of different heights. The supporting table (7) is of the overhung type, in order to accommodate ring shaped pieces.



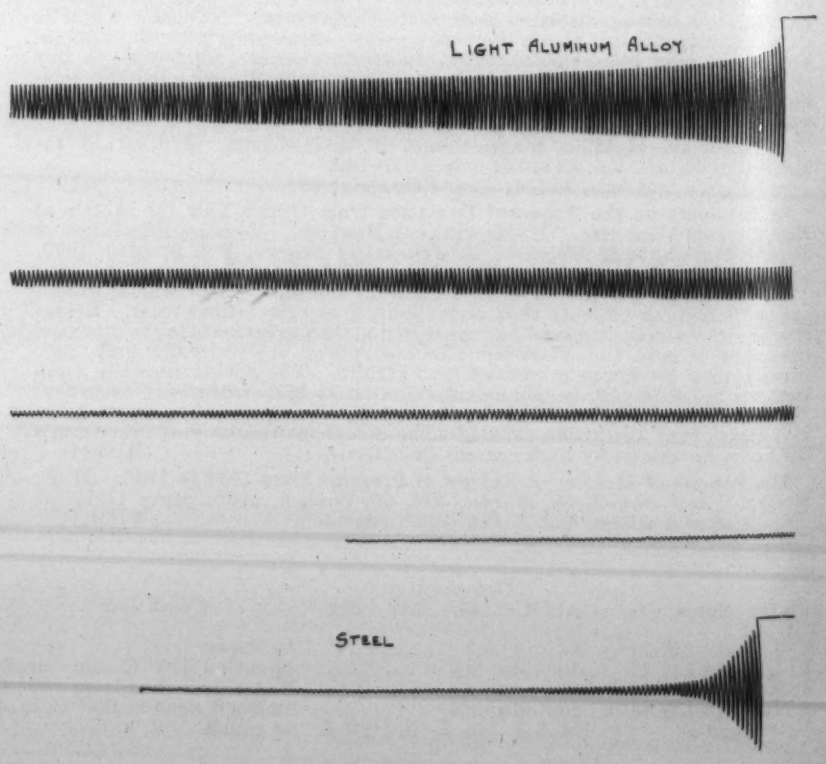
An innovation in this machine is the arrangement of the hollow bronze screw (5) which is rotated automatically when turning the main screw (1) under small loads. At higher loads, the screws disengage automatically, leaving screw (1) to do the final loading. By this construction, the diameter of screw (1) can be kept reasonably small, enabling the easy operation of the machine. The machine is sold in this country by the Southwark Foundry and Machine Company. It is 21″ × 19″ × 8″ without the handles and weighs 100 lbs.

Damping Tester for the Determination of Internal Friction of Materials

The Foeppl-Pertz damping machine sold by Southwark Foundry & Machine Company, Philadelphia, Pa., consists of a frame (1), hung from the ceiling on a wire (2) about 10 ft. long. This unusual way of mounting the machine is one of the special features which provide the high accuracy needed in determining



the small amounts of work absorbed by internal friction in the specimen (3). The test rod (3) is rigidly clamped at its bottom into the frame (1) by means of heavy screws and carries on its top an oscillating mass (4), which makes a reciprocating rotary movement about the axis of the specimen, twisting the same back and forth. A small pivot (5) avoids any lateral movements, so that the stresses in the specimen are purely torsional. The test itself is started by twisting the mass (4) to a desired amount and holding it in a twisted position by means of adjustable electromagnets (6). Upon breaking the electrical circuit of which the magnets' coils are a part, a free oscillation is produced. The stylograph (7) attached to the mass (4) records a damped free vibration diagram on the chart moved by the clockwork (8).



These curves are obtained in a few minutes and represent the damping characteristic of the material which can be replotted in the form of diagrams, showing the amount of work absorbed in relation to the rate of stress. The overall dimensions are 24″ × 12″ × 10″ and the weight is 160 lbs.

(Continued on Page 30)

The Aluminium-Brasses. R. GENDERS. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 163–186.
Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. (2)

Properties of Strontium-Tin Alloys. K. W. RAY. *Industrial & Engineering Chemistry*, Vol. 22, May 1930, pages 519–522.
Thermal diagram, photomicrographs, specific gravity, hardness, rate of corrosion of strontium-tin alloys up to 30% Sr were studied and the results are given. 7 references. MEH(2)

Bearing Metals and Bearings. W. M. CORSE. *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 179–203.
Paper presented before the Detroit Chapter of the Society, Nov. 1929. Discusses the properties of good bearing materials and a description of white metals, bronzes and graphite bearing metals. The use of various common tests, factors of design and lubrication are discussed. WLC(2)

Brass and Modern Brass Production. (Messing und Moderne Messingfabrikation.) K. GROTEWOLD. *Zeitschrift für Feinmechanik und Präzision*, Vol. 38, Oct. 17, 1930, pages 1–5.
A short review of the various kinds of brass, either pure copper-zinc alloy or with other metal additions especially for use in the optical industry as they are produced in the Brass Works, Hirsch, Eberswalde, Germany. Ha(2)

A New Silicon-Zinc Alloy. E. VADERS. *Engineer*, Vol. 150, Sept. 26, 1930, page 336.
Abstract of paper read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. LFM(2)

Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys. E. VOCE. *Engineer*, Vol. 150, Sept. 26, 1930, pages 335–336.
Abstract of papers read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 899. LFM(2)

White Metals, Brasses and Bronzes. Part 5. E. PERRY. *Metal Industry*, N. Y., Vol. 28, May 1930, pages 225–226.
Special yellow brasses contain in addition to Cu and Zn, Al, Fe, Pb and Sn. Al increases strength of brass and acts as deoxidizer. In all brass mixtures Cu is melted first and Zn last. Mixtures high in Cu should be poured at high temp. while high in Zn at low temperature. Contains a table giving representative brass mixtures. VSP(2)

Manganese Bronzes. *Machinery* (London), Vol. 36, May 29, 1930, pages 261–262.
Describes physical properties and composition of Mn alloys for various purposes as well as Mn and Si bronzes; Mn and Al bronze; and Mn additions to brass. Includes tables giving data on physical tests on Mn bronze in chill cast condition; physical tests of Mn in cast alloys; and typical Mn bronze castings. (2)

Aluminum Sheet Production. ROBERT J. ANDERSON. *Metallurgia*, Vol. 2, Sept. 1930, pages 173–176; Oct. 1930, pages 211–214; Vol. 3, Nov. 1930, pages 4–8.
Bibliography of 12 references. Lists sizes, gages, tolerances, tempers and compositions of aluminum and alloy sheets commercially produced. JLG + GTM(2)

Properties of Lead-Bismuth, Lead-Tin, Type Metal and Fusible Alloys. J. G. THOMPSON. *Bureau of Standards Journal of Research*, Vol. 5, Nov. 1930, pages 1085–1107.
The tensile strength, hardness and elongation of a number of lead alloys have been determined and are presented herewith. Data on the solidification characteristics and on the resistance to compression of some of the alloys also are presented. The alloys studied are divided into 4 classes: (1) Binary alloys of lead and bismuth, (2) binary alloys of lead and tin, (3) type metals, with and without the addition of small amounts of bismuth, and (4) fusible alloys of bismuth, lead, tin and cadmium. The data are presented both in tabular form and in graphs. (2)

A New High-Strength Aluminum Alloy (Hyblum). ARCHIBALD BLACK. *Airway Age*, June 1930, page 784.
In recent years duralumin has won favor with aircraft designers. Now a new alloy, under the market name of Hyblum, has been invented. It weighs slightly less than duralumin and its cost is appreciably lower on account of the facility with which it can be rolled. Tests made upon Hyblum indicate, writes the author, that the material possesses qualities desirable in airplane construction. It has more ductility and resists corrosion from salt water better than the commercial grades of duralumin. (2)

An Air-Hardening Copper-Cobalt Alloy. CYRIL STANLEY SMITH. (American Brass Co.) *Mining & Metallurgy*, Vol. 11, April 1930, pages 213–215.
Experiments carried out by author on some Cu-rich Cu-Co alloys showed very marked air-hardening properties. Alloys used contained from 2 to 5% Co and hardened by quenching from above 850° C. If alloy containing from 1 to 5% Co is quenched rapidly from a high temperature at which it is pure α, it will be retained in this condition and remain a homogeneous solid solution at room temperature. Tabulates results of rate of cooling from 900° C. on hardness of a Cu-Co alloy, 3.58% Co. Formation of sub-scale seems to be due to diffusion of O through solid metal, resulting in formation of CoO. VSP(2)

PROPERTIES OF FERROUS ALLOYS (3)

A New Case-Hardening Steel. *Automobile Engineer*, Vol. 20, June 1930, page 204.
Description of a free cutting, case-hardening steel produced by the British Rolling Mills, Ltd., Tipton, Staffs and known as Brymill C. H. 2. Claimed to machine well at high speeds and yet is not brittle and is suitable for case-hardening. RHP(3)

Rustless Chromium-Manganese Steels Have Deep-Drawing Qualities. FREDERICK M. BECKET. (Electro Metallurgical Co.) *Iron Age*, Vol. 125, May 15, 1930, pages 1468–1470.
Includes discussion. Takes up chiefly Cr-Mn steels with 10 to 30% Cr, 3 to 30% Mn, 0.05 to 2% C, 0.02 to 3% Si, 0.10 to 0.5% Ni, max. P 0.025% and S 0.01%. Ingots varying from 2 × 2½ × 6 in. to 6 × 6 × 18 in. and 8 × 8 × 31 in. Steels containing more than 16% Cr are markedly changed by increasing additions of Mn. About 6% Mn changes physical properties of this type of steel. Steel of low C content, as Mn increases have greater elongation and area reduction. Experimental work on deep drawing showed that for a given Mn content the low C steels are superior. The high Cr-Mn steels (over 20% Cr) possess greater resistance to attack by a larger number of chemical substances. For hot rolling purposes temperatures between 1200° and 900° C. were found satisfactory. Cr-Mn steels will withstand greater amount of cold work than Cr steels. For pickling a solution of 1–2% HF and 5–10% HNO_3 used between 50° and 70° C. is suitable. Successful deep drawing has been performed on low C, 17 to 18% Cr steels, containing 7% Mn. Copper addition to Cr-Mn steels enhances their properties. VSP(3)

A New and Ingenious Direct Steel and Metallic Process. *South African Mining & Engineering Journal*, Vol. 41, Part 1, April 19, 1930, page 198.
Pulverized ore and coal are repeatedly showered through hot reducing gases while descending by gravity through an inclined rotary kiln. The product is discharged to an electric furnace where it is showered through the arc. Physical tests on the resulting steel are given. AHE(3)

Recent Investigations in Cast Steel. (Neuere Untersuchungen an Stahlguss.) UDE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Oct. 4, 1930, pages 1399–1401.
Review on some tests of notch-toughness and tensile strength of cast steel at higher temperatures, up to 500° C., and different heat treatments. Curves and 5 references are given. Ha(3)

Alloy Steel Castings. J. GALIBOURG. *Technique Moderne*, Vol. 21, Dec. 1, 1929, pages 754–755.
Abstract of a paper presented at the Oct. 1929 meeting of the 8th Foundry Congress in Paris. (3)

Nickel-Copper-Chrome Cast Iron. (Ueber Nickel-Kupfer-Chrome-Gusseisen.) M. WAEHLERT & H. OSTERMANN. *Chemische Fabrik*, Sept. 24, 1930, pages 377–378; Oct. 1, 1930, pages 386–388; Oct. 8, 1930, pages 402–404.
Paper presented before the "Dechema" in Frankfurt a.M. contains 3 references. Ni-Cu-Cr cast iron or "Nimol" is made by adding about 20% monel metal scrap and 2 to 4% Cr to cast iron, in some cases as high as 20% Cr. The Ni:Cu ratio is 2:1. Nimol is austenitic, non-magnetic, machines as well as cast iron and resists corrosion very much better than cast iron. Comparative tests were made on 15 compositions of unalloyed, low alloy and high alloy cast iron on various Si and C contents. Brinell hardness of Nimol is lower than cast iron. The 13% Ni iron consists of austenite and martensite. With rising Ni content the solubility of Cu in cast iron increases. Summary of corrosion tests:

Relative loss in weight per unit of surface and time

	Nimol	Unalloyed Iron	Cast Brass	Bronze 90 Cu –10 Sn
5% H_2SO_4 at 20° C.	1	475	1.12	1.08
5% H_2SO_4 + 5% H_2O_2 at 20° C.	1	25.4	1.18	1.22
10% H_2SO_4 at 95–100° C.	1	1.95	.15	.15
60° H_2SO_4 at 95–100° C.	1	1.95	—	.08
5% HCl	1	185	13	24
25% acetic acid	1	400	2.75	2.22
Sea water	1	5	.1	2.15
20% NaCl spray	1	2.9	.27	.08

Annealing at 650° C. makes Nimol magnetic and martensitic, except Mixture No. 13, containing 5% Ni and 6% Cu. At 850° C. the unalloyed irons change to ferrite and the surface oxidizes. After annealing at 925° C. Nimol hardly oxidizes, and has very little growth, while unalloyed cast iron oxidizes badly. Mixture No. 13 still remains austenitic and its hardness does not change. Unalloyed irons soften in annealing while Nimol hardens at the lower and then softens at the higher temperatures. Tested at elevated temperatures the tensile strength of 20% Nimol falls off evenly. Nimol can be poured at 1300–1350° C. It welds easily by autogenous and electric process. It is especially useful as a corrosion and heat resisting alloy and is cheaper than brass and bronze. CEM(3)

Gray Iron Possesses Valuable Engineering Properties. Part VI. *Foundry*, Vol. 58, July 1, 1930, pages 94–97.
The most commonly used test for foundry Fe is the transverse strength test. Ultimate fiber stress for gray Fe is shown by modulus of rupture which is calculated from transverse test values. Wide use is made of arbitration test bars of fixed dimension for comparative testing. Minimum test values for various grades are:

	Breaking load lbs.	Deflection inches
Gray iron, light	1500	0.20
Gray iron, medium	1750	0.20
Gray iron, heavy	2000	0.20
Soil pipe and fittings	1500	0.20
High test gray iron	2500	0.24
British grade A	1950	0.15
British grade C	1600	0.12

Employment of moduli of rupture calculations appears the only logical means of making comparisons of various Fe in various shapes and sizes of test bars. In true gray Fe the intrinsic strength of metal in a series of bars decreases as the cooling rate becomes slower. Slow cooling promotes more complete graphitization and coarser grain, consequently weaker metal. The stronger Fe has higher moduli of elasticity in transverse as well as in tension. Gives number of graphs and tables. VSP(3)

Data on Manganese Structural Steels with Chromium Additions. A. B. KINZEL & W. B. MILLER. *Transactions American Society for Steel Treating*, Vol. 18, July 1930, pages 55–69.
A paper presented before the semi-annual meeting of the Society in New York, Feb. 7–8, 1930. Includes discussion. A series of Cr-Mn steels of 0.08–0.50% C, 0.6–1.8% Mn with additions of 0.3–1.1% Cr were studied showing a beneficial effect of Cr in increasing the ultimate strength without loss of ductility. The results obtained show such steel to have possibilities in the general structural field, in the as rolled or normalized condition. A practical application to the construction of a welded pressure vessel is discussed. In discussion, the use of such a composition for seamless tubing is touched upon by A. V. DeForest (Spang Chalfant Co.). Mr. W. J. Merten mentions the difficulties in heat treating heavy sections of such steel and the effect of Cr on the grain refinement. WLC(3)

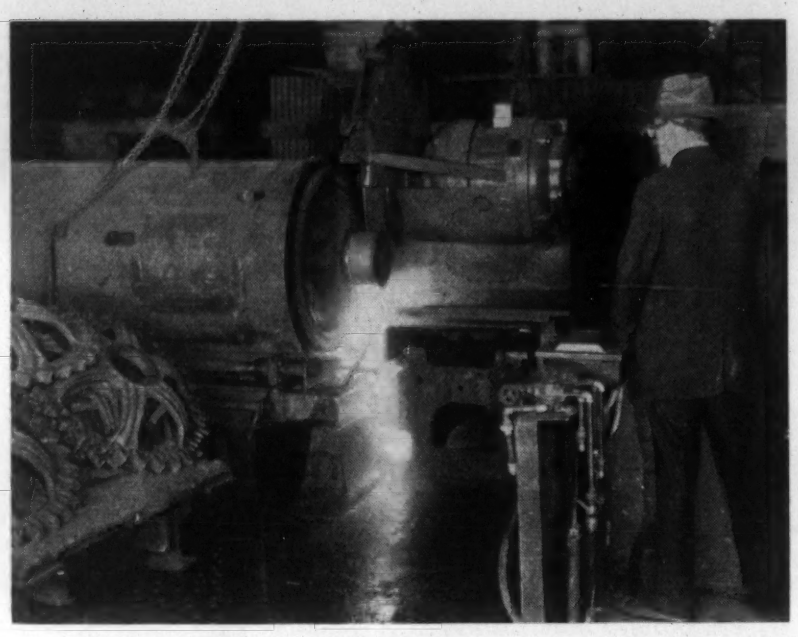
The Physical Properties of Pure Chrome-Steels and Tungsten-Steels. (Die physikalischen Eigenschaften von reinen Chrom- und Wolframstählen.) F. STÄBLEIN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, April 26, 1930, page 541.
Tests with a chrome-steel of 24% Cr and a tungsten-steel of 28% W showed the following after annealing several hours at 800° C.: the density follows closely the one determined by the rule of mixing, i. e., it is reduced for each 1% of Cr by 0.0083, increased for each 1% of W by 0.048. The specific resistance is increased for each 1% Cr by 0.062, by each 1% W by 0.017 Ohm/mm.^{2} up to 2% Cr or 7% W. For higher percentages somewhat different values are obtained. Heat conduction of pure iron is reduced by almost half by the addition of 5% Cr and reaches a minimum at 17% Cr of 0.05 cal./cm. sec. degree. For about 14 to 30% W the heat conductivity is about 0.09 cal./cm. sec. degree. W produces a very high remanence. The thermal expansion did not give very simple relations. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 337. Ha(3)

Alloy Steels for Locomotive Construction. W. ARNOLD JOHNSON. *Proceedings Institution of Mechanical Engineers*, No. 5, 1929, pages 1087–1097.
Abridged from a paper read before the Graduates Section, Northwestern Branch, in Manchester, Oct. 11, 1928. Even after the best heat-treatment, those carbon steels which can be suitably worked and manufactured, can only be relied upon to give a tensile strength of about 55 tons/in.^{2}. Carbon steel of this tensile strength usually has low impact resistance. Alloy steels may be treated to give a tensile strength of 40–110 tons/in.^{2} and still give satisfactory impact values. The effect of vanadium in steel on the dynamic strength or resistance to fatigue is even greater than on its static properties. Discusses chromium-vanadium steel, "Vibrac" steel, which is a nickel-chrome-molybdenum steel, German steel of 0.1–0.15%C and 0.67–1.5% Si, and manganese steel. Corrosion of boilers, strength of connecting rods and other locomotive parts and the materials best suited to the place are discussed. RHP(3)

New Use for High Speed Friction Saws

By associating methods in industry, many important problems are solved. It was through such association that a high speed friction saw was put in service for cutting off casting risers.

A representative of the Harrison Company visited a plant recently, where a Ryerson Friction Saw was cutting through heavy structurals. The ease and speed with which the cuts were made led him to believe that casting risers could also be cut off by this process. Several tests were made and his convictions proved correct, for this company has not only increased production through the use of The Ryerson Friction Saw, but it has also saved considerable expense by eliminating all grinding on many jobs.



The cost of grinding wheels is an important item and when the torch burning process is used this cost cannot be avoided. About $^1/_4$ inch of the riser remains to be ground because if the torch were allowed to cut flush with the casting, part of the casting would be burned. In most cases where a high speed friction saw is used a flush cut is accomplished.

The illustration shows the high speed friction saw installed at the Harrison plant.

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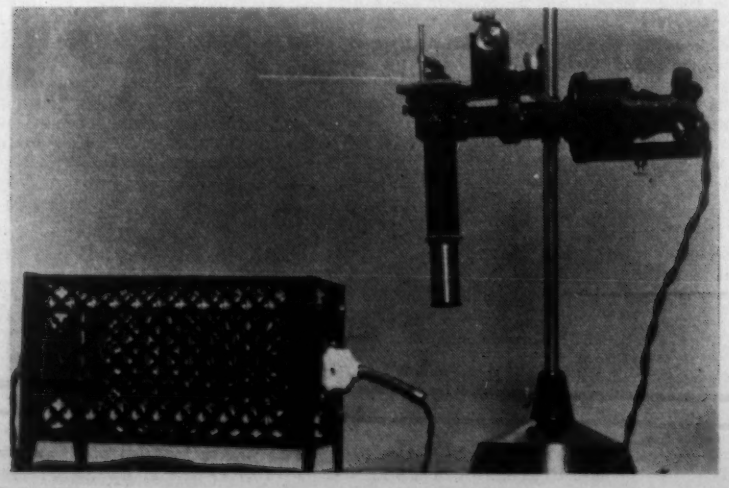
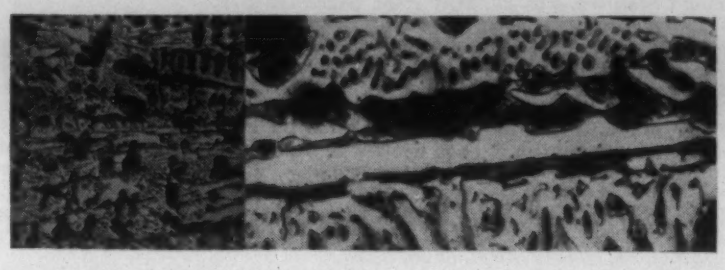
New Metal Microscope

The construction of this microscope, marketed by the Clay-Adams Company, is based on the Le Chatelier principle. It combines the principle of the inverted metallurgical microscope with the ease and convenience in handling of the usual type without in any way affecting the optical advantages of the former.



Its optical features are the same which are found on large metallographic benches with the exception that the totally reflecting prism used for visual examination is fixed so that the same ocular serves for both examination and photography. To accomplish this the illuminating system and the microscope itself, which are connected in one rigid body, are made to rotate in the vertical plane so that after location of a desired spot the image obtained can be projected in any given direction either onto the table or a screen or photographic plate. The light source is a special 6 volt lamp. The optical system is good, both in resolving power and strength of light. A properly exposed negative at 2000 magnifications calls for about 30 seconds exposure time. Projected on a screen until the field is four feet diameter the image is perfectly bright and what is even more important, the image is perfectly flat without any distortion at the edges whatever. The microscope is very simple to operate.



Magnification 100 × Magnification 2000 ×
Micrographs of same sample of cast iron reduced to $^1/_3$ of the original.

Once adjusted the illuminating system does not require any attention and final focusing is reduced to a few seconds time. The objective remains stationary while the stage, to which the specimen is fastened with a spring clamp, is moved both by the coarse and fine adjustment screws.

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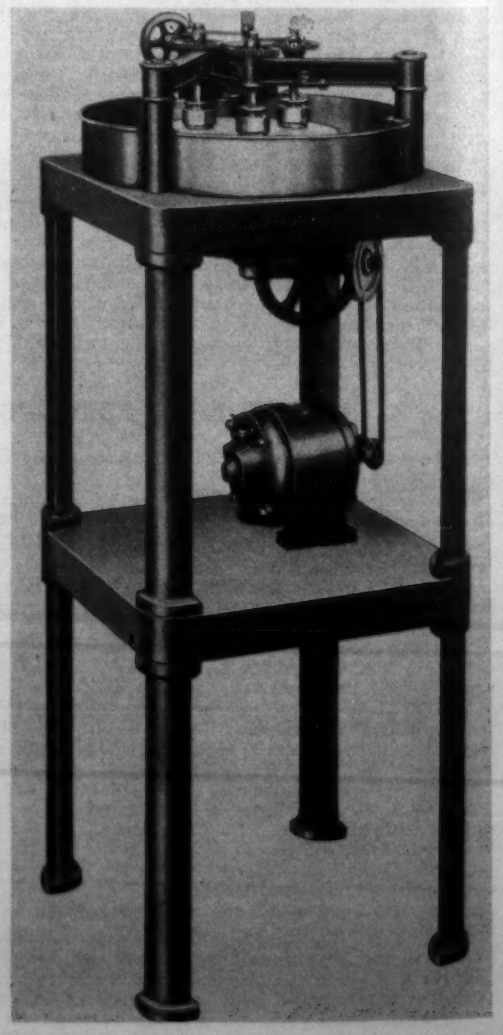
Metallographic Polishing Machine

The new Aminco automatic metallographic polishing machine has a polishing head covered with a suitable polishing cloth. This head is mounted on vertical spindles, running in ball bearings, and is driven by a belt from a motor.

Resting on the polishing disk may be seen 3 specimens in their brass ring holders. These holders float on the polishing cloth and change their positions slightly as the contour of the cloth changes. The specimens are held lightly against the cloth by spring rods which bear on the exact centers of the specimen holders. At the top of each specimen spindle is a rigidly attached gear, which meshes with an eccentric gear. This eccentric gear gives the motion to the specimens which so largely contributes to the perfect work done by the machine. It is accomplished as follows:

The eccentric gear is driven through a speed reducer and as it rotates it causes the 3 specimen holder gears also to rotate. Being meshed with an eccentric gear, the 3 specimen holder gears not only rotate on their own axes, but they continually oscillate toward and away from the center of the polishing disk. Thus the specimen has the following motion:

It is free to move vertically within limits. It rotates on its own axis. It is slowly moved from the outer edge to the center of the polishing disk and the result of this motion is a perfectly polished specimen.



The new Aminco automatic metallographic polishing machine eliminates the "personal equation" and produces a high grade of work. It will very quickly save many times its cost in any metallurgical laboratory.

This machine will polish 3 different specimens at one time. The specimens need not even be of the same metal, providing they fall into such a classification that they can be polished with the same material, and on the same cloth. This machine is manufactured by the American Instrument Co., Washington, D. C. and is modeled on the one designed at the Bureau of Standards and described in METALS & ALLOYS, Vol. 1, Nov. 1929, pages 226–230.

(Continued on Page 32)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

The Corrosion Resistance of Al-Dur-Bra. *Metal Industry* (London), Vol. 37, July 18, 1930, pages 59–61.

Al-Dur-Bra is an Al brass cast by the Durville process composed of 76% Cu, 22% Zn and 2% Al. It is a homogeneous solid solution—the α solution—of the ternary system Cu–Zn–Al. Mechanical properties are superior to brasses of 70:30 type. Due to its ductility it is easily worked, hot or cold. Its corrosion resistance is due to the fact that during annealing or hot working, it oxidizes or scales very little. Gives various applications. Its manufacture is covered by British patent No. 308,647. VSP(4)

High-Pressure and High-Temperature Steam for Locomotives. C. F. Hirshfeld. *Preprint, American Society of Mechanical Engineers*, Dec. 1–5, 1930, 7 pages.

Certain experiences and observations regarding the behavior of metals and the boiler circulation under extreme conditions are given, and these are followed by speculations regarding the possible lines of development of locomotives. (4)

High-Performance Gasoline Aircraft Engine—Its Problems of Fuel, Oil and Materials of Cylinder Construction. S. D. Heron. *Transactions, American Society of Mechanical Engineers, Aeronautical Engineering*, Vol. 2, Oct.-Dec., 1930, pages 233–253.

Section 4 of this article is entitled: Corrosion and Attack due to Fuel in Aircraft Engines. In this section the author discusses cylinder corrosion, valve corrosion and attack, exhaust disposal system, valve-seat insert attack, valve gear and spark plugs. (4)

Wear Oxidation, a New Component of Wear. Max Fink. *Transactions, American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 204–212.

The summary of a thesis for Dr.-Ing. degree at Technische Hochschule Berlin-Charlottenburg, Germany. Includes 7 references. The oxidation accompanying wear as previously observed is discussed. Various wear testing machines are described. Tests on an Amsler wear testing machine excluding oxygen from the specimens resulted in no loss of weight. The 3 essential components of wear are (1) mechanical removal of particles, (2) cold hardening, (3) wear oxidation. WLC(4)

Corrosion and Protective Films. A. C. Hanson (Rock Island Arsenal Laboratory). *Industrial & Engineering Chemistry*, Vol. 22, May 1930, page 554.

As a result of two microscopic observations of the action of water containing respectively oxygen and carbon dioxide, on polished steel, it is thought that the first action is given by the equation $Fe + 2H^+ (ionic) + 2(OH)^- = Fe^{++} (ionic) + 2(OH)^- + H_2$. A film of ferrous hydroxide protects the metal. Carbon dioxide then reacts with this film, forming soluble ferrous acid carbonate, which is later precipitated as ferric hydroxide after dissolved oxygen has acted upon the ferrous salt. MEH(4)

Report of the Commission on Testing Metals and Alloys at Elevated Temperatures (Comptes-Rendus des travaux de la commission des essais à chaud des metaux et alliages). J. Galibourg. *Revue de Metallurgie*, Vol. 27, Aug. 1930, pages 439–442.

French Association for testing materials proposed a few years ago a tentative organization for investigation of the properties of metals at elevated temperatures. Its constitution is given. JDG(4)

The Influence of Copper on the Rusting Reaction of Copper Steels in Atmosphere and in Different Waters. (Ueber den Einfluss des Kupfers auf den Rostvorgang gekupferten Stahles an der Atomsphäre und in verschiedenen Wässern.) C. Carius & E. H. Schulz. *Mitteilungen aus dem Forschungs-Institut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund*, Vol. 1, No. 7, 1929, pages 177–199. 20 references.

Copper steel when in water solutions forms a copper oxide film which prevents further corrosion. See *Metals & Alloys*, Vol. 1, March 1930, page 426. GTM(4)

Metallurgy and Power Industry. J. B. Romer. *Metals & Alloys*, Vol. 1, Dec. 1930, pages 868–870.

Boiler materials must be capable of withstanding high stresses, high temperatures and extremely corrosive conditions. Super-heater equipment must withstand a loss of strength at high temperatures. Creep tests permit a measurement of this property. Austenitic chrome nickel alloy yields excellent service for superheater construction. The material is also widely applicable in the oil industry. No. 1100 metal is useful for boiler parts such as hangers which require huge corrosion resistant properties. ESC(4)

The Problem of Corrosion of Ferrous Metals. V. Sallard. *Technique Moderne*, Vol. 21, Nov. 1929, pages 673–681.

A general review of the causes of corrosion and of corrosion and heat resistant steels and alloys. Among the materials considered are 3% nickel steel, Invar, nickel-chromium-iron alloys (Ni 8.0, Cr 17.0). Corrosion resistant cast iron (0.85% Ni) is also briefly discussed. (4)

The Open-Air Corrosion of Copper. Part II. W. H. J. Vernon & S. Whitby. *Engineer*, Vol. 150, Sept. 26, 1930, page 335.

Abstract of paper read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 843. LFM(4)

Influence of Cyclic Stress on Corrosion. D. J. McAdams, Jr. (U. S. Naval Eng. Exp. Station). *Technical Publication* No. 329, *American Institute of Mining & Metallurgical Engineers* (1930) 42 pages.

Endurance samples were corroded in water sprays while undergoing various alternating stresses, and their apparent endurance limit then determined. The alloys tested were carbon steels, alloy steels, monel metal, brass, duralumin and an Al-Mn alloy. The results are completely reported in the form of curves. The damage done is estimated from the difference in endurance limit between the corroded and uncorroded samples. Even very low alternating stresses increase the damage by corrosion. For steels and Al alloys stresses as low as 2000 lbs./in.^{2} have an appreciable effect. Corrosion resistant alloys are damaged if the stress-corrosion time is sufficiently long. Contains 13 references. JLG(4)

Corrosion and Metal Protection in Boiler Practice. R. Stumper. *Metals & Alloys*, Dec. 1930, page 895–896.

A translation. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 902. ESC(4)

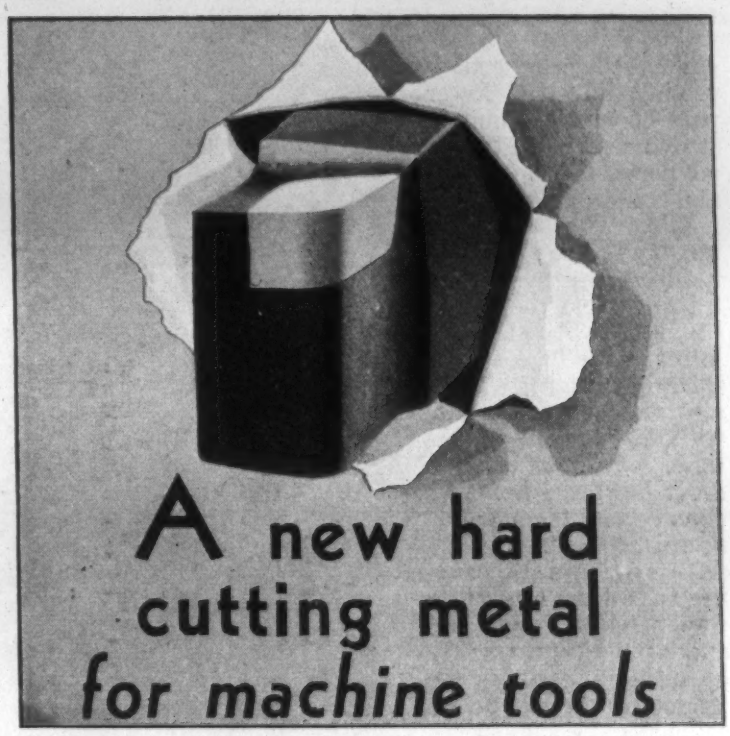
The Effect of Brines on Metals. (Die Einwirkung von Kühlsolen auf Metalle.) T. Liepus & H. Osterburg. *Metallwirtschaft*, Vol. 9, Oct. 31, 1930, pages 904–906.

The usual brines consist of NaCl, $MgCl_2$, $CaCl_2$ solutions, or mixtures of these. The sediment which accumulates in these solutions is due to impurities. The attack of brines on metals consists of both electrolytic action and direct corrosion. The action of 5 solutions made from chemically pure salts and of one commercial product on Fe, Cu, Zn, Sn and Al was studied and some of the results are described and shown by curves. CEM(4)

Castings that Withstand Heat and Corrosion. W. F. Furman. (Duraloy Co.) *Iron Age*, Vol. 125, May 1, 1930, pages 1277–1280, 1359.

Ni-Cr coatings for use at high temperatures were first introduced in 1914. A typical analysis was 60% Ni and 12% Cr, the remainder mostly Fe. Castings in which Ni predominates are used for temperatures of from 2100° to 2200°F. Casting problems are many. Melting is done usually in arc-type electric furnaces. Correct pouring temperatures are important. The fluid metal solidifies much faster than Fe or steel. High Cr-Fe alloys are much used in corrosion resisting field. VSP(4)

RAMET



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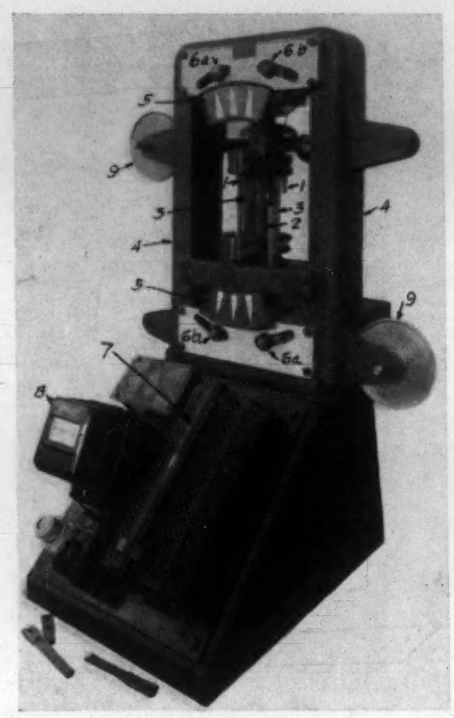
Bending Machine for Static and Repeated Reversed Loads

A knowledge of the endurance properties of all machine parts subjected to repeated stresses, is very important. Consequently endurance or fatigue tests become more and more essential. An ideal fatigue machine should permit the different "short time" determinations of the fatigue limit to be made. This limit is defined as that stress that can be withstood for an indefinite number of stress cycles without fracture of the specimen. The Foeppl-Heydekampf machine sold by the Southwark Foundry and Machine Company, Philadelphia, Pa. will make the above tests using a test piece of simple shape.



The frame of the machine (4) is a light alloy casting into the lower part of which is built a switch panel containing all necessary operating and controlling instruments. The bottom of the specimen (1) is rigidly clamped to the frame (4) and the top is connected with an oscillating mass (2) of considerable length. Usually the tests are run with 2 specimens at a time. The machine may, however, be used equally well for a single specimen. Two thin flat springs (3) are mounted in a similar way between frame (4) and oscillating mass (2), but they are not intended to break, being thinner than the specimens. The springs (3), the specimens (1), and the mass (2) form a mechanical swinging system, which is excited by 2 pairs of electromagnets (6a) and (6b), alternately giving impulses to the mass (2). The magnets are switched on and off by a special lever contact device, not visible in the illustration. The switch lever is moved by the mass (2), due to friction, so that the number of impulses agrees with the natural frequency of the oscillating system. The exciting magnetic forces change their direction in the end position of the swing. Once slightly touched by hand, the system starts and keeps on swinging "in resonance" and requires very low power (not over 0.3 kw.). The amplitude of the oscillation is varied by changing the current in the electromagnets (6) by adjusting the rheostat (7).

The oscillation is a rotary reciprocating movement of the mass about an axis through the middle of the specimen. The angular amplitude can be read from special visual reading devices (5) attached to the ends of the mass (2). Both devices give the same reading, checking each other. The stress in the specimens is proportional to the amplitude within the range of Hooke's law. It can be directly figured from the readings on the scale (5). If Hooke's law is exceeded, the exact determination of the stress must be made by an additional static loading arrangement furnished with the machine. The pulleys (9) and some other weighing and measuring equipment not shown in the figure permit finding the actual stress strain relation, thus eliminating the usual error, due to figuring the stress according to Hooke's law. This static weighing device also eliminates the errors based on the assumption that the clamps are rigid, since the amount of yield in the grips is measured in the static test.

The stress is constant over the full gage length of the specimen. The acceleration forces during the oscillation are pure moments. The center of gravity of all moving parts is in a stationary position, so that a pair of accelerating forces is always generated. The stress distribution over the length is as uniform as the one in tensile specimens and the simple shape of the latter without reduced sections or tapers is readily applicable for fatigue tests on this machine. The failures are, therefore, not restricted to a certain part of the specimen, but occur where the weakest point of the material happens to be, thus clearly revealing any lack of uniformity of the material tested. The uniform stress distribution is also applied in the static bending test.

The number of cycles is counted by an electrical counter (8) driven by a small synchronous motor in series with the pulsating current line feeding the electromagnets. As a matter of fact, the number of electric impulses is counted, which, however, is equal to the number of oscillations or stress cycles, due to the resonance principle applied. An automatic adjustable contact mechanism stops the machine after a failure.

The specimens do not rotate and have an unusually large part of their total volume subjected to the testing stress. The machine is, therefore, particularly convenient for any of the proposed "short time" tests, e. g., rise of temperature method or electrical resistance method. It also permits with more than the ordinary facility the study of the mechanical hysteresis effect to which property the names "damping capacity" or "dynamic ductility" have also been applied. The machine weighs 180 lbs. and is 22″ × 30″ × 39″.

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Ramet—A New Cutting Material

Ramet is a new cutting material developed by the Fansteel Products Co., Inc., Chicago, Ill.

As this material is produced at present, metallic tantalum, in a powdered state, is converted to carbide. The carbide is ground to extreme fineness in a mill, addition of a certain amount of nickel being accomplished at this time. The ground powder is then pressed into the shape of finished blanks and heat treated.

The blanks are brazed to steel shanks, then the tools ground to the desired finished shape.

Tantalum carbide is not easily "wet" with other metals. While this necessitates a special operation before the material can be brazed, it is of great advantage to the ultimate user, especially when machining steel, as hot chips will not alloy with the tool. Therefore no pitting or abrading takes place.

The special operation for brazing Ramet consists of a special heat treatment in a controlled atmosphere, followed by nickel plating. In this condition the material can be brazed easily with pure copper or any of the common brazing alloys.

An interesting characteristic of Ramet is its high melting point, which is approximately 4400° C. Metals of the tantalum-columbian-vanadium group apparently produce carbides with melting points higher than those of the parent metals; while tungsten carbide melts at 2700° C., far below the melting point of tungsten metal.

The ultimate tensile strength of Ramet is 250,000–300,000 lbs./in.^{2} This factor is watched very carefully, and a sample of each lot of Ramet is tested by the laboratory.

Another outstanding characteristic, and perhaps the most useful from a tool standpoint, is low thermal conductivity, which results in both the tool and the work remaining remarkably cool, even when turning red hot chips. Comparative tests have been made where an alloy tool was permitted to run until the tip became red hot and the shank began to turn blue. Without changing the feed or speed, a Ramet tool was substituted, and allowed to operate for the same length of time. Upon stopping the machine, the Ramet tool could be handled with bare hands. This is explained by the fact that when a tool is sharp, practically the only heat generated is within the chip, the only heat reaching the tool or work being that which the tool conducts away from the chip.

This low thermal conductivity is of advantage to users because it keeps tools, machines and work cool. It is of advantage to tool makers because it practically eliminates the difficulty of tips loosening because of softened brazing. Experiments have been made successfully with tools brazed with zinc, which held perfectly. In fact, in all the tests which have been made with Ramet tools, there is not yet a single case of failure due to softened brazing.

Tests seem to indicate a great deal of success for Ramet in the machining of steel, cast iron, bronze, aluminum, duralumin and synthetic plastics.

◆ ◆ ◆

The need for avoidance of embedded particles of iron or iron oxide on polished austenitic corrosion-resistant steels and rustless irons has led to the introduction of polishing pastes in which rouge or other materials containing iron oxide are carefully avoided. One of these, called Alumilite Paste has been developed by the E. Reed Burns Mfg. Corp., Brooklyn. It is said to be non-magnetic and is made solely of artificial abrasives of different grain sizes, combined with the correct amount of lubrication to meet proper polishing wheel speeds.

It is generally used on a sewed rag wheel following the last dry "set-up" abrasive wheel in order to produce the "bottom" so necessary to subsequent high mirror finishes.

It may also be used on a Tampico Bristle Brush to produce a brush finish.

◆ ◆ ◆

The Institute of Metals has just issued the first number–dated January 1931–of its new monthly Journal containing original articles, Institute news and abstracts of the world's metallurgical literature–96 pages in all. Hitherto the Journal has appeared in the form of half-yearly volumes divided into two Sections: "Proceedings" and "Abstracts." Henceforth the volumes issued each June and December will contain only "Proceedings," and the "Abstracts" will appear monthly–to be re-issued in volume form at the end of each year.

Cadmium versus Zinc Plating as Rust Preventives. W. S. PATTERSON. *Chemical Age*, Vol. 23, Aug. 2, 1930, Metallurgical Section, pages 7–8.

A condensation of a paper, "The Resistance of Electrodeposits to Corrosion, with Special Reference to Cadmium and Zinc." before the Electroplaters' and Depositors' Technical Society. Deposits of cadmium and zinc on 0.18% carbon steel were made from the following solutions:

Zinc Solution		*Cadmium Solution*	
Zinc sulphate	300 g.	Cadmium oxide	24 g.
Sodium chloride	13 g.	Sodium cyanide	66 g.
Boric acid	20 g.	Water	1 l.
Aluminum sulphate	26 g.		
Dextrine	13 g.		
Water	1 l.		

The thickness of the coatings were 0.65 mil. for cadmium and 0.70 mil. for zinc. They were then exposed (1) in an indoor unpolluted atmosphere, (2) swimming pool atmosphere containing chlorine, and (3) outdoor atmosphere.

(1) Mean weight increments, milligrams

	90 days	250 days
Zinc plated	1.1	2.7
Cadmium plated	1.8	2.0

(2) Mean weight increments, grams/in.²

	96 days	175 days	272 days
Zinc plated	0.59	0.81	1.5
Cadmium plated	0.59	1.1	2.8

(3) Mean loss in weight mg./in.²

	93 days	185 days	267 days
Zinc plated	2.4	14.8	19.6
Cadmium plated	9.7	43.9	72.7

A check on (3) follows:

Loss in weight, mg./in.²

	76 days
Zinc plated	8.2
Cadmium plated	21.4
Pure zinc	6.5
Pure cadmium	17.7

The author states that cadmium plating is satisfactory for indoor exposure but that zinc is to be preferred for outdoor exposure. The cause of the more severe attack of the cadmium plated material outdoors he considers to be the formation of soluble corrosion products with the cadmium coating as opposed to the formation of insoluble corrosion products with the zinc coating. VVK(4)

Corrosion of Nitrided Steels. LEON GUILLET & MARCEL BALLAY. *Iron Age*, Vol. 125, May 22, 1930, page 1531.

In a report to the Paris Academie des Sciences, Dec. 1929, the authors discussed corrosion resistance of steels case hardened by ordinary methods and by nitriding. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 792. VSP(4)

White Rust of Galvanized Wares. E. H. SCHULZ. *Iron Age*, Vol. 125, May 29, 1930, page 1610.

Abstract translation of article in *Stahl und Eisen*, Vol. 50, March 20, 1930, pages 360–362. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 793. VSP(4)

Corrosion Meeting of the Deutsche Gesellschaft für Metallkunde. *Metals & Alloys*, Vol. 1, July 1930, page 613.

Abstracts of papers presented at the Berlin meeting. ESC(4)

Protective Electroplating on Aluminum Alloys. *Metallurgist*, July 1930, pages 103–104.

An extended abstract of a paper before the Electroplaters' and Depositors' Technical Society on "The Protection of Aluminium and Its Alloys by the Deposition of Zinc," by Dr. H. C. Cocks. The following metals were plated: commercial aluminum, commercial British duralumin, the sand-cast aluminum alloys L5, L11, L24 and D.T.D.25, mild steel, copper and brass. A large number of the test pieces were subjected to corrosion tests, the entire investigation extending over 2 years. Both sulphate and cyanide baths were investigated. It was found that practically all the deposits from the sulphate baths gave very good protection to aluminum and aluminum alloys. The protection afforded by the cyanide baths, although good, was not equal to that from the sulphate baths. The ammonical zinc cyanide bath showed no appreciable superiority over the sodium zinc cyanide sodium zincate bath. The bath recommended for aluminum and its alloys is zinc sulphate (crystal) 145 g./liter, sodium acetate (crystal) 35 g./liter and gum arabic 1 g./liter. A current density of 30 amp./ft.² should be used with the solution at pH 4.0. VVK(4)

Thickness of the Oxide Film which Produces Temper Colour on Iron. MASAO KURODA. *Scientific Papers, Institute of Physical & Chemical Research*, Vol. 14, Sept. 20, 1930, pages 145–152.

A piece of mild steel which had been heated to about 400° C., the surface tarnished to dark blue, was polished so slightly that the steel surface does not appear. The color of that part became a yellowish brown which corresponds to the temper color at a lower temperature. According to the depth of the groove produced by the polishing, the temper color was changed from the former to the latter. The depth was measured by making a light beam interfere in the space between that plane and an optically flat surface of glass, and the value of 40.5$\mu\mu$ was obtained. On the other hand, a series of temper colors was made by heating pieces of mild steel to different temperatures. The temper colors were subjected to photometric measurements and the wave lengths of the ray having the maximum intensity in the beams of dark blue and yellowish brown were 450$\mu\mu$ and 630$\mu\mu$, respectively. The refractive index for the film (n = 1.70) was calculated from these wave lengths and the depth of groove. This value practically coincides with that of iron oxide, showing that the interference theory agrees with the results of the experiment. TS(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Macrostructure of Cast Alloys: Effect of Turbulence Due to Gases. R. GENDERS. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 187–192. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. (5a)

The Composition of Eutectics. D. STOCKDALE. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 193–216.

Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 794. (5a)

The Diffusion of Zinc in Copper Crystals. C. F. ELAM. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 217–235.

Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 794 (5a)

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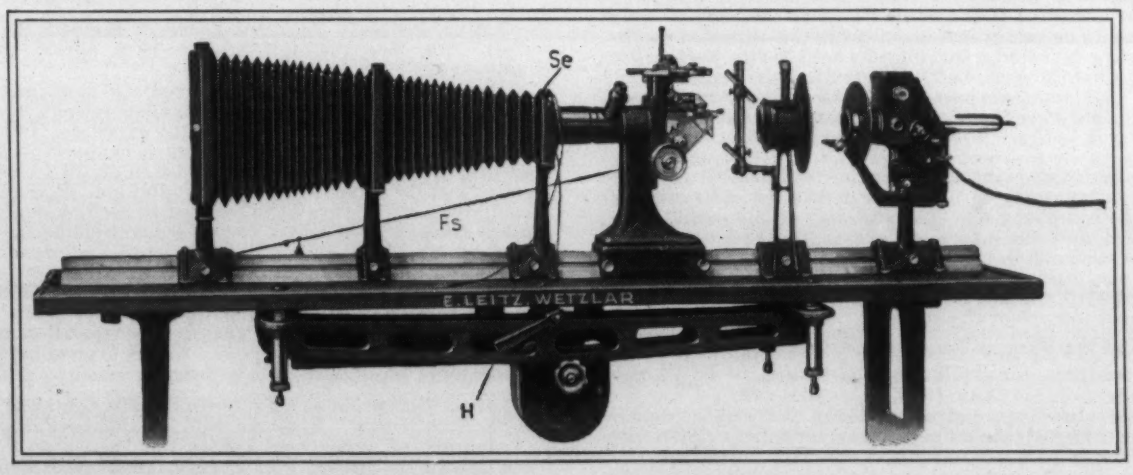

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The Gamma-Alpha Transformation in Pure Iron. ALBERT SAUVEUR & C. H. CHOU. *American Institute Mining & Metallurgical Engineers, Transactions, Iron & Steel Division* (1929) pages 350–369.
Includes discussion. A microscopic study of drastically quenched electrolytic iron showed a martensitic structure. The martensitic structure was found to be in effect a *Widmanstätten* structure. Transformation of γ to α iron occurs first at grain boundries and then along octahedral planes. JLG(5a)

Structure of Hypoeutectoid Steel. ALBERT SAUVEUR & C. H. CHOU. *Foundry Trade Journal*, Vol. 42, June 12, 1930, page 439; *Iron & Coal Trades Review*, Vol. 120, May 30, 1930, page 880; *Fuels & Furnaces*, Vol. 8, April 1930, pages 491–493.
Abstract of paper on, "Influence of Rate of Cooling on Dendritic Structure and Microstructure of Some Hypoeutectoid Steel," before the American Institute of Mining and Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 564. MS+RHP+VSP(5a)

Pure Iron and Allotropic Transformations. T. D. YENSEN (Westinghouse Elec. and Mfg. Co.). *American Institute Mining & Metallurgical Engineers, Transactions, Iron & Steel Division* (1929) pages 320–349.
Includes discussion. Suggests that pure iron has no allotropic transformations. 26 references. JLG(5a)

A Study in the Relation between Macro- and Microstructure on Some Non-Ferrous Alloys. MARIE GAYLER. *Engineer*, Vol. 150, Sept. 19, 1930, page 319.
Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. LFM(5a)

The Automatic Maintenance of Solid-Liquid Equilibrium in a Metal. PAUL A. ANDERSON. *Review of Scientific Instruments*, Vol. 1, Dec. 1930, pages 764–767.
Article describes a method for automatically maintaining a bath of zinc in two-phase equilibrium through the increase in specific resistance attending isothermal fusion. (5a)

The Constitution of the Alloys of Iron with Silicon. JOHN L. HAUGHTON & MAURICE L. BECKER. *Iron & Coal Trades Review*, Vol. 120, May 9, 1930, pages 759–760; *Foundry Trade Journal*, Vol. 42, May 22, 1930, pages 379–380.
Abridged from a paper before the British Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 794. VSP + RHP(5a)

The Solubility of Gold in Mercury. II. ARTHUR A. SUNIER & CHESTER M. WHITE. *Journal American Chemical Society*, Vol. 52, May 1930, pages 1842–1850.
Amalgams as dilute as 0.3% have been prepared and analyzed, by a method described, with a precision approaching one part in a thousand. The solubility found is 0.1306 atomic % at 20°, which is about 2 oz. per 100 lbs. of Hg. MEH(5a)

Graphite in Cast Iron ARCHIBALD ALLISON. *Foundry Trade Journal*, Vol. 42, June 5, 1930, pages 417–418.
Physical properties of cast Fe are largely governed by the quantity and form of graphite it contains. Coarse graphite produced in pig Fe by smelting does not completely dissolve, but remains as an emulsion in molten metal, and in solidification forms nuclei for the formation of coarse graphite flakes. This is based upon the presence of kish. Graphite in pig Fe of very open fracture appears as coarse flakes in a matrix of ferrite. Precipitation of graphite is produced by sulphide crystals acting as nuclei. A radial structure in the nodule itself indicates that in the annealing process dissociation of carbide and precipitation of graphite originated in center proceeding outward. VSP(5a)

The Structures of the High Chromium Stainless Steels and Irons. E. C. BAIN (U. S. Steel Corp). *Advance Copy, American Iron & Steel Institute*, Oct. 1930, 26 pages; *Blast Furnace & Steel Plant*, Vol. 18, Nov. 1930, pages 1690–1697; *Fuels & Furnaces*, Vol. 8, Nov. 1930, pages 1531–1535.
Only solid solution Cr, and not chromium carbide, is effective in producing stainlessness. It has been suggested that ferritic Fe-Cr alloys need 15% Cr plus 16 times the C content, to be safely rust-resistant in the annealed condition. C must be held low, or by rapid quenching be held in the martensitic state, or, by addition of another element, as Ni, the steel may be kept austenitic at room temperature. By some of these means the Cr may be almost all held in solid solution so that it is effective. The metallography of these steels, therefore, refers largely to the details of the behavior of the chromium carbide. Equilibrium diagrams for carbonless Fe-Cr, Fe-Ni and Ni-Cr are given, followed by diagrams showing the behavior and constitution of alloys of 14% and 18% Cr with varying carbon content, 18% Cr with varying Ni, and 18% Cr, 8% Ni with varying C. The stability of the carbide, its behavior on heat-treatment and the effect upon corrosion-resistance and embrittlement, are followed through in all these compositions. The hardening of the austenitic alloys by cold work is discussed. The paper is a very concise survey of a complicated subject and will be especially valuable to those wishing a clear general picture of the subject. HWG(5a)

Stability of Cementite and the Various Forms of Carbon. (Om cementitens och de olika kolmodificationernas stabilitetsförhållanden.) G. Phragmen. *Jernkontorets Annaler*, Vol. 114, Aug. 1930, pages 431–442.
Critical review of the literature, the conclusion being that the evidence indicates that cementite becomes stable at higher temperatures. 24 references. HCD(5a)

On the Nature of the Transformations of β-Phase in the Copper-Tin Alloys. 1st Report. HIROSHI IMAI & ICHIJI OBINATA. *Memoirs of the Ryojun College of Engineering*, Vol. III, Aug. 1930, pages 117–135.
Eleven alloys of Cu–Sn system containing 20–33% tin were prepared and the electric resistance-temperature curves and the differential thermal curves were taken with annealed and quenched specimens. The effect of the cooling rate on the structure of quenched specimens was also studied. From these results the authors obtained the conclusions that the eutectoid change of the β-phase proceeds in the 3 steps according to the scheme, $\beta \longrightarrow \beta' \longrightarrow \beta'' \longrightarrow \alpha + \delta$. The quenched specimens show the marked changes at 200°, 250° and 350° C. on heating curves. The first is due to the change $\beta \longrightarrow \beta'$, the second, to that of $\beta' \longrightarrow \beta''$, and the third, to that of $\beta'' \longrightarrow \alpha + \delta$. This view was further confirmed by the change of the electric resistance of specimens during holding at several temperatures. The martensitic structure which is observable in quenched alloys with less than 25% tin is the mixture of β- and β'-phase, owing to the incomplete transformation of the change $\beta \longrightarrow \beta'$. The change taking place at 590° in the β-phase is not due to the change of phase but to that of atomic energy as the A_2 transformation in iron. TM(5a)

The Solubility of Silver in Copper. (Ueber die Löslichkeit von Silber in Kupfer.) F. MÖLLER. *Metallwirtschaft*, Vol. 9, Oct. 24, 1930, pages 879–885.
The solidus line of Cu-Ag alloys at the Cu end was determined by electrical resistance measurements at various temperatures. The greatest solubility of Ag in Cu is 7%. The shape of the resistance-temperature curves is different for different % Ag. Equilibrium weights agree better when determined in cooling than by the same rate in heating. The author's results are compared with those of Hirose, Johansson and Linde and Weinbaum. A procedure for the X-ray study of Cu-Ag alloys is outlined. CEM(5a)

A Note on the Constitution of Cadmium-Zinc Alloys. D. STOCKDALE. *Engineer*, Vol. 150, Sept. 26, 1930, page 337.
Abstract of paper read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. LFM(5a)

On the heterogeneous Structure of Martensite. (Ueber die sogenannte Heterogenität des Martensits.) E. MAURER & G. RIEDRICH. *Archiv für Eisenhüttenwesen*, Vol. 4, Aug. 1930, pages 95–98; *Stahl und Eisen*, Vol. 50, Oct. 9, 1930, pages 1431.
The investigation clears up the question as to whether the carbon in quenched steels is uniformly distributed or not. The opinion of a non-uniform distribution is based on the fact that a non-uniform distribution of cementite is found after drawing the hardened steel between 600° and 650° F. Since these findings could be due to concentration changes during drawing, microscopic examinations of hardened hypo- and hyper-eutectoid steels were carried on. In order to obtain clear evidence of possible changes in the distribution of cementite in drawing, certain spots of the hardening structure were examined after drawing at various temperatures. These investigations on a 1.7% C steel and a 0.58% C steel prove that the distribution of cementite is uniform at low drawing temperatures, but differences in the distribution are observed after drawing at high temperatures, which firmly assures that there is a uniform distribution of carbon in the quenched samples. In order to explain the hardening structure of hypo-eutectoid steels, steels with 0.05, 0.12, 0.20, 0.45, 0.58, 0.75 and 0.86% C were studied Two distinct structural constituents could be observed in the steels from 0.45% to 0.86% C after etching with nitric acid, dark colored needles and spots in a bright etching matrix of fine needles. The dark constituent is drawn martensite; the bright constituent non-drawn martensite. The originating of the dark constituent is rendered more difficult by a quicker quench and a higher manganese content. GN(5a)

A Study of the Iron-Chromium-Carbon Constitutional Diagram. V. N. KRIVOBOK (Carnegie Institute of Technology) & M. A. GROSSMAN (Republic Steel Corp.) *Transactions American Society Steel Treating*, Vol. 18, July 1930, pages 1–48.
Paper presented before the 11th Annual Convention in Cleveland, Sept. 9–13, 1929. Includes discussion and 7 references. Previous studies have covered Cr content up to 18% and the present paper deals with the changes in the microstructure of alloys of higher Cr 20–35% and C 0.10–0.60%. The findings of previous work showing a γ-iron loop and the effect of C content on the austenite range are discussed in relation to the observations made on the alloy. Three sets of alloys of 22%, 28% and 33% Cr were studied respectively with C varying between 0.10% and 0.60% and tables of their microconstituents are given. These results are plotted into a ternary diagram. The areas where iron occurs alone, where it occurs with carbide and with austenite are shown. The opposite effects of C and Cr on the promotion or suppression of the γ-range are shown to be the same in these higher alloys as in the lower one previously studied. The paper contains 37 micrographs of the structures observed. An appendix covering a thermal analysis of certain of the alloys by the author is added. WCL(5a)

Structure & X-ray Analysis (5b)

X-Ray Apparatus Used in Portable Setup. *Iron Trade Review*, Vol. 86, Feb. 6, 1930, pages 73–76, 80.
See "X-Raying Large Steel Castings," by Ancel St. John & Herbert R. Isenburger, in *Metals & Alloys*, Vol. 1, July 1930, page 628. MS(5b)

The Application Possibilities of X-Ray Stereogrammetry for the Location of Defects in Testing of Materials. (Die Anwendungsmöglichkeit der Röntgenstereogrammetrie zur Fehlerortsbestimmung bei Materialuntersuchung.) H. WENDT. *Bildmessung und Luftbildwesen*, Vol. 5, Aug. 1930, page 140.
By giving a proper shape to the anode surface Götze succeeded in obtaining an almost point-like source of the rays in the X-ray tube. Several such tubes are described and methods for evaluation of the pictures discussed. Ha(5b)

X-Ray Prevents Foundry Losses. WILBUR S. WERNER. (Kelly-Koett Co.) *Iron Age*, Vol. 125, May 1, 1930, pages 1290–1291; May 15, pages 1466–1467.
Radiographic method is preferred for most metal examinations. First, the film presents more minute details; second, the heavier metals such as Fe, Cu, Sn and their alloys, a lengthy exposure; third, film gives a permanent record. Present limiting thickness of common metals commercially tested: $3^1/_2$ in. of Fe, $2^1/_2$ in. of brass or Cu, 8 or 10 in. of Al or equivalent of any other metal. Steel alloys offer individual problems depending upon their composition. X-rays have assisted in perfection of art of welding. Welded parts are now used where they were considered inapplicable. Fluoroscopic method is confined chiefly to light metals and organic substances, and finding defects in manufactured articles. Ionization testing is not in common use because of its limitations. One of the greatest fields for X-ray inspection is in the examination of fine structure, determination of grain size, crystal structure and orientation, chemical composition and existence of strains. Valuable aid in heat treatment. Gives typical layout for a complete X-ray laboratory. VSP(5b)

Lattice Distortion as a Factor in the Hardening of Metals. W. L. FINK & K. R. VAN HORN. *Engineer*, Vol. 150, Sept. 19, 1930, page 319.
Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. LFM(5b)

Photo-Ionization of Caesium Vapor by Absorption between the Series Lines. C. BOECKNER & F. L. MOHLER. *Bureau of Standards Journal of Research*, Vol. 5, Oct. 1930, pages 831–842.
Measurements by the space-charge method were made on photo-ionization resulting from a small continuous absorption between series lines. (5b)

Recrystallization of Electrolytic Copper after Hot Rolling. W. TAFEL. *Metals & Alloys*, Vol. 1, Jan. 1930, pages 347–349.
Translation from *Zeitschrift für Metallkunde*, Aug. 1929, page 265–267. See abstract in *Metals & Alloys*, Vol. 1, Jan. 1930, page 340. (5b)

The Technique of Radiography and Gamma Rays. CHARLES S. BARRETT, ROYAL A. GEZELIUS & ROBERT F. MEHL. *Metals & Alloys*, Vol. 1, Dec. 1930, pages 872–879.
Gamma rays can be used in the place of X-rays. The apparatus is simpler and the penetrating power is greater which multiplies the possibility of application. Materials which fluoresce under the action of γ-rays can be made into effective intensifying screens. Calcium tungstate is satisfactory. It is customary to use duplicate films separated by a lead screen. Observations are described which determine the curve of depth in inches of iron plotted against time of exposure. Curves are given for 2 arrangements of screens and one density from a distance of 18". Other screens or densities move the curve along the abscissa. For exposure at d inches the time is multiplied by $d^2/18$. Gamma-ray photographs show less contrast than X-ray photographs. The ratio of the intensity of the unabsorbed rays to that of the rays that have passed through the casting is much greater for X-rays than for γ-rays. Also the angular distribution of the intensity of the scattered rays is a cause of less halation with γ-rays. Data are given regarding these factors which permits calculation of the fogged area under given conditions. ESC(5b)

The Development of Modern X-Ray Generating Apparatus. W. D. Coolidge (General Electric Co.). *General Electric Review*, Vol. 33, Nov. 1930, pages 608–614; Dec. 1930, pages 723–726.

An abstract of a paper delivered as the "Caldwell Lecture" before the American Roentgen Ray Society at West Baden Springs, Sept. 24, 1930. Its purpose was to emphasize some of the fundamental principles involved, so as to show why X-ray generating apparatus has its present limitations and to indicate in a few cases how the capabilities of the apparatus may be increased in the future. Various types of X-ray tubes and the preparation of the metallic tungsten filament are illustrated. WHB(5b)

X-Ray Inspection of Castings. *Journal Society Automotive Engineers*, Vol. 25, Nov. 1929, page 551.

A discussion of the value of X-ray analysis of castings. X-ray inspection is found to be used successfully in the examination of cast steel, bronze and aluminum, as well as in some other cases. (5b)

An Instrument for High Voltage X-Ray Spectrography and Radiography. F. Sillers, Jr. (Follansbee Bros. Co.). *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 220–234.

Contains 5 references. The paper describes the author's X-ray outfit using voltages of 200 kv. to take simultaneously 4 X-ray spectrograms, of comparable intensities, from samples of silicon sheet steel. By rotating the X-ray tube 90° on its axis the outfit may be used for radiography. The author discusses the use of this instrument for the inspection of electrical sheet steel of high silicon content. WLC(5b)

Study of the Grain Structure of Martensite. K. Heindlhofer & E. C. Bain (U. S. Steel Corp.). *Transactions American Society for Steel Treating*, Vol. 18, July 1930, pages 70–125.

A paper presented before the semi-annual meeting of the Society in New York, Feb. 7–8, 1930. Includes discussion and 9 references. New data on the crystal structure of martensite obtained by X-ray methods and the use of the petrographic microscope are presented. The authors conclude that the "Unit" or grain size of martensite is not small, as formerly held from the diffuse lines of the X-ray spectrum, but large; and that the diffuse lines are due to a random irregularity of the "solid solution type." A twisting or bending type of distortion between the planes of as much as 4° is noted. The hardness of martensite appears to be largely due to the solid solution irregularity and to a smaller extent to the twisting of the planes. In discussion, Dr. H. H. Lester (Watertown Arsenal) confirms the author's view of the grain size of martensite and the predominance of the solid solution effect. The body of the paper treats in considerable detail the technique involved in careful X-ray measurements and the use of the petrographic microscope in the authors' research. WLC(5b)

Note on the Use of Gamma Rays for Examining Welds. R. F. Mehl (Naval Research Laboratory), G. Doan (Lehigh University), & C. S. Barrett (Naval Research Laboratory). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 104–106.

Describes method used for examining heavy castings and welds for internal defects. Radium apparatus consists of capsule about size of cartridge containing source of rays. Its small size allows it to be used on top of partly constructed buildings or even under water. Welds can be radiographed in places inaccessible to usual apparatus. The bulb of radium emanation is supported in front of weld with photographic film fastened behind weld. Flaws in weld show up on developed film just so in ordinary X-ray radiographs. Gamma rays have power of penetrating much greater thicknesses than X-rays. It is possible to take radiographs through 1 ft. of steel. High penetrating power causes defects to show up with less contrast than with X-ray but good pictures of irregular thicknesses are easier to obtain. Not expensive method because radium can be rented from hospitals. Gives 2 radiographs of welds showing defects. LFM(5b)

An X-Ray Investigation of the Lead-Antimony Alloys. D. Solomon & W. Morris Jones. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Sept. 1930, pages 470–475.

8 references. Crystal structures were examined by the X-ray powder method. Photographs were taken of Sb, Sb 70% and Pb 30%, Sb 20% and Pb 80%, and of Pb. The results are tabulated in 4 tables which show the quality of the copper radiation, a copper target was used in the experiment, second the Miller indices of the reflecting planes, third the intensities of the lines on the photograph, fourth the plane spacings obtained from measurements on the film, and fifth the calculated spacings for the structure found. X-ray analysis does not indicate a solid solution at either the Pb or the Sb end of the diagram. There are no definite compounds in the Pb-Sb system of alloys, and if Pb is soluble in Sb or Sb in Pb the degree of solubility of either metal in the other is very small at room temperature. The work of Dean, Broniewski and Sliwowski is briefly reviewed. This work agrees with that of Dean but not with other 2 who claim formation of a solid solution. RHP(5b)

The Electron Theory of Metals in the Light of the Wave-Mechanical Statistics. (**Zur Elektronentheorie der Metalle nach der wellenmechanischen Statistik.**) A. Sommerfeld. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, May 10, 1930, pages 585–588.

Many questions regarding physical properties of metals could not find a proper explanation without leading to contradictions in the classical theory. Drude explains a new theory of metals which is based on wave-mechanics and the "Pauli" prohibition and "Fermi" statistics. The former states that each quantum-state can exist only once in the whole system of a metal atom, and according to the Fermi-statistics the electron is not only to be considered as a corpuscle, as in the classical theory, but also as a wave-state. These new ideas have had excellent results as now specific heat, electric-resistance, and the emission of electrons from a metal, even at low temperatures, can be fully explained in conformance with the observed facts. The Pauli-prohibition has found the finest confirmation in the theory of the spectral phenomena and in the structure of the atoms in the periodic system. The electric resistance is proportional to the free length of path, that is, the average length between 2 collisions of an electron with the metal ions, and as the free length is proportional to the absolute temperature, the resistance behaves in this manner. The new theory shows that the old Maxwellian views are right above a certain temperature while below that down to absolute zero the curve of the velocity of electrons assumes a constant value. The average energy of an electron is not dependent on temperature. The double nature of the electron as corpuscle and as wave as now received, has been of eminent consequence in modern physics. Ha(5b)

X-Ray Examination of the Modifications of Manganese. (**Röntgenographische Untersuchungen der Manganmodifikationen.**) Einar Oehman. *Metallwirtschaft*, Vol. 9, Oct. 3, 1930, pages 825–827.

Contains 17 references. Three modifications of pure manganese have been found by X-ray examination. α is stable from ordinary temperature to 742°C., β from 742° to 1191°, and above 1191° C. γ exists. The rate of transformation from one modification to another is retarded by Al and Fe impurities in Mn, therefore, technical Mn is usually a mixture of $\alpha + \beta$, and never contains any γ. The elementary length of α Mn is 8.894 A.U., β 6.300 A.U. The interference lines of α do not coincide with those of β. γ has not yet been obtained by quenching pure Mn from high temperatures. The lattice dimensions of γ can be determined by interpolation from several Mn–Cu alloys. γ exists only in electrolytic Mn. It is face centered tetragonal while α and β are cubical. CEM(5b)

The Industrial Use of X-Ray Interference Methods. (**Die industrielle Anwendung der Röntgen-Interferenzmethoden.**) Alfred Reis. *Metallwirtschaft*, Vol. 9, May 30, 1930, pages 468–470.

A discussion of the advantages of the powder method of X-ray examination, the necessary conditions for its use, description of the process. Use of X-ray examination for control work, for purchased materials and products of manufacture. Micro examination for structure versus macro examination for flaws and defects. CEM(5b)

Lattice Disturbances on Gliding Surfaces, from an X-Ray Examination of Rock-Salt. (**Ueber Gitterstörungen an Gleitflächen, nach einer röntgenographischen Untersuchung aus Steinsalz.**) Wolfgang Berg. *Wissenschaftliche Veröffentlichungen aus den Siemenskonzern*, Vol. 9, No. 2 (1930) pages 119–143.

The different properties of crystals can be divided into two classes: integral properties which bring the whole crystal into action, and differential properties which depend on the quality of the crystal at different places, where consequently the defects of the crystal come into play. To the former belong, thermal conductivity, specific heat, elasticity modulus, properties which are independent of the defects of a crystal while some mechanical properties, tensile and compression strength, ion-conductivity, dielectric-strength are differential properties. To the latter belongs also the fact of the existence of certain preferred gliding surfaces. To explain these properties the defects have to be taken into account. The author develops an apparatus for obtaining a photograph by a simple reflection of a limited X-ray beam on a crystal. For rock-salt this picture shows regularly arranged light and darker stripes. The behavior of the stripes under different test conditions permits a conclusion as to the kind of deformation of the lattice at the gliding surface. The observation of the strips offers a very sensitive method for the determination of gliding surfaces and gliding directions in mono-crystals; the same good results can be expected also in metal crystals. Ha(5b)

The X-Ray Examination of Atomic Structure. (**Die Untersuchung der Atomenordnung mittels Röntgenstrahlen.**) W. Lawrence Bragg. *Metallwirtschaft*, Vol. 9, May 30, 1930, pages 461–465.

Contains 6 references. A review. The principle of X-ray examination is the same as microscopic examination, waves are used to illustrate structure. In micro examination a picture results, in X-ray study calculations are necessary to obtain results. Examples are given. X-rays should be regarded as a new source of illumination for microscopy, not as a new science. The relative position of atoms can be studied with X-rays. CEM(5b)

The Structure of the Spectrum of Singly Ionized Zirconium. C. C. Kiess & Harriet K. Kiess. *Bureau of Standards Journal of Research*, Vol. 5, Dec. 1930, pages 1205–1239.

Seventy-five percent of the lines observed in the spark spectrum of zirconium have been classified as combinations between terms of the quartet and doublet systems of Zr II. The terms which have been found are in all cases those required theoretically for an atom with three outer electrons. All the terms, except one, which can possibly arise from configurations of the electrons when they occupy 4d, 6s and 5p orbits have been found. Of the terms possible when one of the electrons removes to a 5d or 6s orbit only a few have been found, of which some form Rydberg series with the low terms. In all, 10 pairs of series-forming terms have been detected with either ^3F, ^1G, or ^1D of Zr III as limit. The results given by these different series for the distance between a $^4F_{1\,1/2}$, the lowest term of Zr II, and a^3F_2, the lowest term of Zr III, are very consistent, the mean value being 113, 175 cm^{-1}, corresponding to an ionization potential of 13.97 volts for the ion Zr^+. The irregular doublet law shows a close parallelism between the term structures of the neutral Yt atom and the singly ionized Zr atom. The list of Zr II lines appearing in the sun is extended and includes lines which have not been observed in laboratory sources but may be calculated from permissible combinations. (5b)

The Soft X-Rays of Manganese. F. C. Chalklin. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 9, May 1930, pages 847–857.

Previous experiments have shown that for each of the elements iron, cobalt, nickel and copper there exists in the soft X-ray region, a considerable number of critical potentials. To account for these Prof. O. W. Richardson and the author have suggested a scheme involving the assumption that the critical potentials are due to transitions from a number of initial levels to a Rydberg series of virtual levels. The present experiment determines the critical potentials of manganese by 2 distinct variations of the photo-electric method. Discusses the apparatus and methods of procedure, and the results obtained from each method. The critical potential scheme advanced by Richardson and Chalklin does not account for the discontinuities found for manganese above 280 volts, and for iron, nickel, cobalt and copper there are unpredicted effects in this region. If the scheme is to be comprehensive it will require extension but the data available at present does not justify such extension. RHP(5b)

Measurement of Lattice Derangements with X-Rays. (**Messung von Gitterstöhrungen mit Röntgenstrahlen.**) J. Hengstenberg. *Metallwirtschaft*, Vol. 9, May 30, 1930, pages 465–468.

Gives 8 references. An X-ray study was made of annealed and rolled metals. The effect of strengthening a metal by working, alloying and heat treating on the lattice change is discussed, the influence of lattice change on the intensity of X-ray reflections and the results of intensity measurements are given. Single crystals are examined. CEM(5b)

An X-Ray Investigation of the Copper-Magnesium Alloys. Geoffrey Grime & W. Morris-Jones (University College, Swansea). *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 7, June 1929, pages 1113–1134.

Eight alloys were examined by the X-ray powder method. Their compositions were determined by an electrolytic method and their densities by the suspension method. The equilibrium diagram of Sahmen was confirmed in its main features. Two new regions of solid solution were detected; 1. The α-phase–as solution of magnesium in the copper lattice up to approximately 3% magnesium. 2. The β-phase–a range of solution extending on either side of the composition represented by the formula Cu_2Mg. This range is estimated to be confined to 2 or 3% on either side of the Cu_2Mg solid solution could not be detected at the maximum end of the diagram. The lattice constants of copper and magnesium were determined. RHP(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Inspecting Bar Stock by Magnetic Analysis. R. R. Moore (Wright Aeronautical Corp.). *Machinery*, Vol. 36, May 1930, pages 672–673.

Abstract of an article appearing in *The Tradewind*. See *Metals & Alloys*, Vol. 1, July 1930, page 629. RHP(6)

An Investigation of the Phenomena of Strengthening of Steel and Its Behavior under Repeated Overstresses. A. Thum & W. J. Wiss. *Transactions American Society for Steel Treating*, Vol. 18, July 1930, pages 49–54.

The paper is a summary of a thesis for Dr. Ing. degree at Technical University of Darmstadt, Germany. The effect of previous stressing on the endurance properties are discussed. By gradually increasing the load on a specimen during an endurance test its endurance limit may be increased about 20%. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 908. WLC(6)

Method and Apparatus for Determination of Ductility and Tensile Strength of Sheet Metals. (Methode et apparail d'essai donnant le coefficient d'extension et la charge de rupture des produits metallurgiques en feuilles.) CH. JOVIGNOT. *Revue de Metallurgie*, Vol. 27, Aug. 1930, pages 443–448.

Inaccuracies of reading in Erichsen type of ductility testers are caused largely by friction of the ball and lack of sharpness in the determination of the end point. In the present apparatus, the ball is replaced by hydraulic pressure applied directly to the sheet held in a die of practically standard design. The apparatus entirely eliminates the drawbacks of friction, sharply defines the end point, gives a direct reading of the depth of the cup, always gives comparable results, indicates the homogeneity of the sample and its readings can be easily extrapolated into figures of tensile strength. Description of the apparatus and conversion graphs into tensile strength are given. JDG(6)

Young's Modulus Determined with Small Stresses. D. K. FROMAN. *Physical Review*, Vol. 35, Feb. 1, 1930, pages 264–268.

A report from Ryerson Physical Laboratory of the University of Chicago on the interferometer method of determining extensions of metallic rods of brass, steel, Cu, Al, and Ni under stresses considerably less than those used in commercial testing. Young's modulus was found to increase very rapidly as stress increased from zero, reach the maximum at comparatively small stress, and then to decrease almost exponentially to ordinary value. (6)

Atmospheric Action in Relation to Fatigue in Lead. BERNARD P. HAIGH & BRINLEY JONES. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 271–295.

Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 795. (6)

The Physical Properties of Basic Bessemer and Open Hearth Steels. (Die mechanischen Eigenschaften von Thomas und Siemens Martin Stählen.) K. DAEVES. *Stahl und Eisen*, Vol. 50, Sept. 25, 1930, pages 1353–1356.

It was found by evaluating a very large number of tests on the physical properties of Thomas and open hearth steels that the Thomas steel has a higher elongation and reduction of area than open hearth steel, of same tensile strength. In evaluating the results of rail steels with from 36–100 kg./mm.^{2} tensile strength for instance, the elongation of the Thomas steels was 2% and the reduction of area 4% higher than for open hearth steels. No reliable information can be given yet as to the metallurgical causes of the difference of physical properties. GN(6)

The Fatigue of Metals. *Machinery* (London), Vol. 36, June 12, 1930, pages 335–338.

A discussion of accelerated fatigue tests and the relation between endurance limit and physical properties. The mechanism of fatigue, corrosion fatigue, stress-cycle curves and notch effects are also considered. (6)

Large Material Testing Machines. (Grossprüfmaschinen.) *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Oct. 4, 1930, page 1399.

Short description of a 100-ton compression testing machine built by Maschinenfabrik Augsburg-Nürnberg. Accuracy of ±1% is guaranteed. Ha(6)

Suggested Methods of Reporting on Nitrided Steel Case. GEORGE M. EATON. *Transactions American Society for Steel Treating*, Vol. 17, June 1930, pages 765–783.

Paper presented before the Semi-annual meeting of the Society in New York, Feb. 7–8, 1930. In the body of the paper, the author suggests the need for uniform methods of reporting nitrided case characteristics, the use of a logarithmic scale of hardness and a plain scale of depth, and a merit factor for wear. Appendices cover the possibilities of the scleroscope for inspection, wear testing, straightening vs. case ductility, and hardness vs. wear resistance. WLC(6)

Strength of Welded Shelf-Angle Connections. JAMES H. EDWARDS, H. L. WHITTEMORE & A. H. STANG. *Bureau of Standards Journal of Research*, Vol. 5, Oct. 1930, pages 781–792.

The specimens were tested to destruction in the 10,000,000-pound testing machine of the National Bureau of Standards. (6)

Transverse Tests of H-Section Column Splices. JAMES H. EDWARDS (American Bridge Company), H. L. WHITTEMORE (Bureau of Standards) & A. H. STANG (Bureau of Standards). *Journal American Welding Society*, Vol. 9, June 1930, pages 7–28.

Reprinted from *Bureau of Standards Journal of Research*, Vol. 4, March 1930. See *Metals & Alloys*, Vol. 1, July 1930, page 629. LFM(6)

Stress Distribution in Welded Steel Pedestals. JAMES H. EDWARDS, H. L. WHITTEMORE & A. H. STANG. *Bureau of Standards Journal of Research*, Vol. 5, Oct. 1930, pages 803–811.

Two welded steel pedestals were tested in compression and a study of the stress distribution was made. (6)

The Damping of Materials at Alternating Normal Stresses and at Alternating Compression Stresses. (Die Dämpfung der Werkstoffe bei wechselnden Normalspannungen und bei wechselnden Schubspannungen.) O. FOEPPL. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Oct. 4, 1930, pages 1391–1394.

The conceptions of damping ϑ and relative damping ψ are explained and the importance of these quantities for the determination of quality of a material is pointed out. The magnitude of damping can be determined at alternating stresses for one element. The damping has been measured on the one side as a function of the normal stress, and on the other as a function of the compression stress. The two curves almost coincide for most of the examined materials if the damping occurring at normal stresses is plotted as a function of the compression stress occurring at 45° to the direction of main stress. The curves for steel, copper, and brass show only very little difference while those for Electron show, however, a much larger, unexplainable difference between torsion and bending. 11 references. Ha(6)

Engine Parts and Metallurgy. (Maschinenteile und Werkstoffkunde.) E. HEIDEBROCK. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 13, 1930, pages 1259–1265.

In the meeting of the committee on machine elements, the influence of experience and research in metallurgy on design was discussed which is reviewed in the paper. The following questions were discussed: the present-day state of metallurgy and its influence on the shape of rigid joints, fatigue tests, strength calculations, shaping of large forgings, parts for high-pressure hot-steam, high speed reciprocating engines, belts, slide-couplings, friction coefficients in bearings at low velocities. The paper can not very well be abstracted in short, it is illustrated by many figures and tables and 14 references. Ha(6)

Hardness by "Cloudburst." EDWARD G. HERBERT. *American Machinist*, Vol. 72, June 5, 1930, pages 917–920.

In the cloudburst a shower of hard steel balls is allowed to fall on the work from a predetermined height. 750,000 steel balls of about 3 mm. are dropped per minute. It tests the whole surface of the work. The parts of less than the specified hardness are identated. Internal surfaces may be tested by use of a deflector. This method will also detect brittleness. See *Metals & Alloys*, Vol. 1, Sept. 1929, page 121. RHP(6)

Stress Strain Relationships in Spring Steels. G. A. HANKINS. *Engineer*, Vol. 150, Aug. 15, 1930, pages 178–179. 7 references.

Communication from the Spring Committee of the Department of Scientific and Industrial Research. Short general discussion of stress-strain relationships in spring steels under conditions which are often assumed to be elastic. Gives experimental results on changes in elastic moduli after excessive over-straining of the material. LFM(6)

The Effects of Two Years' Atmospheric Exposure on Breaking Load of Hard-Drawn Non-Ferrous Wires. J. C. HUDSON. *Engineer*, Vol. 150, Sept. 26, 1930, page 335; *Engineering*, Vol. 130, Oct. 17, 1930, pages 507–508.

Abstract of paper read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. LFM(6)

Creep Limit under Alternating Tension and Compression. (Der Fliessbeginn bei wechselnder Zug-Druckbeanspruchung.) W. KUNTZE & G. SACHS. *Metallwirtschaft*, Vol. 9, Jan. 24, 1930, pages 85–891.

Contains 3 references. Stress-strain diagrams of metals were determined on cylindrical test pieces, using an alternating tensile and compressive load, which was gradually increased. The difference between the first and subsequent curves is called Bauschinger effect. The Bauschiner effect starts suddenly at a point independent of the conventional elastic limit and yield point and its relation to the elastic limit is different for different materials. It is called the alternating elastic limit. With cold worked metals this limit is lowered at the second reversal in load with low load amplitude and then reappears at the typical point for that metal. CEM(6)

Determination of the Hot Yield Point of Steel. (Zur Bestimmung der Warmstreckgrenze von Stahl.) F. KÖRBER & A. POMP. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, Report No. 155 (1930) pages 165–169; *Stahl und Eisen*, Vol. 50, Oct. 9, 1930, pages 1443–1444.

The investigation determined the hot yield point of an open hearth steel of the following composition: 0.046% C, 0.18% Si, 0.33% Mn, 0.020% P and 0.028% S by studying (1) the influence of the time during which the load is applied on the value of the hot yield point, (2) the influence of the number of the load steps on the value of the hot yield point and (3) the influence of the time which passes after the removal of the load applied on the value of the hot yield point. The load which is necessary for obtaining a permanent elongation of 0.2% of the test length of a bar is defined as hot yield point. The velocity of the load increase amounted to 0.5 kg./mm.^{2} per second. The load was kept constant at the various load steps (3 to 6) for the following times: 10, 30, 60, 300, 600 and 1800 seconds. The temperatures used were; 300°, 400°, 450°, 500°, 550° and 600° C. The results are: (1) A lowering of the hot yield point occurs at all temperatures with increasing load time. The slope of the curves is most pronounced within the time range between 10 and 300 seconds. In increasing the time during which the load is applied above 300 seconds no essential further decrease of the hot yield point is observed. Comparing the values of the hot yield point for 10 and 1800 seconds, a decrease of 13.6% was found at 300°, 11.3% at 400°, 22.8% at 450°, 37.5% at 500°, 28.0% at 550° and 34.3% at 600° C. These observations, which point out the large influence of the factor at issue on the determination of the hot yield point, explain the discrepancies in the literature referring to this subject. (2) The influence of the number of load steps was studied at 300° and 500° C. The number of the load steps amounted from 2 to 4 and from 12 to 15, respectively. The load time amounted to 10 and 500 seconds, respectively. It results that the number of the load steps is practically without influence on the value of the hot yield point. (3) The waiting time after removing load applied has no bearing on hot yield point. GN(6)

Present-Day Experimental Knowledge and Theories of Fatigue Phenomena in Metals. Report of Research Committee on Fatigue of Metals. H. F. MOORE, Chairman. *Preprint for* Vol. 30, Part I, 1930. *Proceedings American Society for Testing Materials*, 52 pages. 117 references.

The status of present knowledge on the determination of endurance limit, types of machines and of specimens, accelerated tests, correlation of endurance limits with other physical properties, effect of range of stress and kind of stress, metallographic features, fracture under repeated stress, mechanical hysteresis, detection of incipient fatigue failures, effect of alloying and heat-treatment, overstressing, understressing, cold working, stress concentration, corrosion-fatigue, and the significance of fatigue test results, are discussed by H. F. Moore, R. R. Moore, J. R. Townsend, J. B. Kommers, H. S. Rawdon, R. L. Templin, H. W. Gillett, T. McLean Jasper and R. E. Peterson. While individual views are given on each topic, the various sections have been checked over by the whole committee. The result is a very concise summary of available information on endurance of metals, but too concise to be effectively abstracted. Professor Moore's closure on significance of fatigue testing is especially important as it emphasizes the fact that fatigue failure is only one of various modes of failure of metals, and that if the life depends on some other factor than the effect of repeated stress, fatigue testing cannot be expected properly to evaluate the usefulness of the metal for such service. HWG(6)

Magnetic Welding of Butt Welds. T. R. WATTS (Westinghouse Elec. & Mfg. Co.). *Journal American Welding Society*, Sept. 1930, Vol. 9, pages 49–68. 6 references.

For magnetographic inspection of welds, the electromagnet used for getting flux through welded structure is placed on under side of the welded plate bridging the weld. Very fine iron powder is sifted upon piece of paper laid on weld. Cracks, blow-holes, poor fusion or similar faults offer higher magnet resistance to the flux, and are indicated by dense collection of fine iron particles directly over fault. A more quantitative weld test is measurement of magnetic potential drop across the weld and for the same distance in the parent metal. Same flux goes through weld and adjacent parent metal hence magnetic potential drop between any 2 points is proportional to reluctance between those 2 points, indicating quality of the weld. Describes simple type of weld test meter which is small and rugged. Results are easily and quickly interpreted by reference to calibration curves. Investigations indicate that magnetic test methods detect serious faults and give more accurate measure of weld quality than other known methods practicable for shop use. LFM(6)

Yield Point of Structural Steel (Report of Research Committee on). M. O. WITHEY, Chairman, *Preprint for* Vol. 30, Part I (1930). *Proceedings American Society for Testing Materials*, 26 pages.

In a coöperative study, the yield point of specimens cut from structural shapes of 16 different sizes and shapes, ranging from $^3/_8$" plate to 26" girder beam and made from steel of 0.14 to 0.29% C, 0.37 to 0.73% Mn, was found to range from 29,000 to 39,000 lbs./in.^{2} depending on variations in rolling and cooling conditions, on finishing temperature, on size of section and position of the specimen in the section. The ratio of yield point by drop of beam to tensile strength ranged from 0.50 to 0.65, hence it cannot be estimated with sufficient accuracy from the tensile values. There was considerable discrepancy between mill tests and the more carefully conducted coöperative tests. A single specimen will not adequately represent the average properties of heavy girder beams and H-column shapes and 3 specimens from intermediate flange, root and web should be taken. If only one is taken, it should come from the intermediate flange. The most representative single specimen is from an intermediate location in plates and angles and from the center of the web in channels and I-beams. HWG(6)

The Notch Toughness of a Few Aluminum Alloys Especially at Low Temperatures. (Ueber die Kerbzähigkeit einiger Aluminium legierungen insbesondere bei tiefen Temperaturen.) W. A. GÜLDNER. *Zeitschrift für Metallkunde*, Vol. 22, Aug. 1930, pages 257–260.

The alloys studied were: Lautal (4.62 Cu, 0.45 Fe, 0.29 Mg, 0.56 Mn, 0.74 Si) of which in one series the rolled alloy was heated to 500° and water quenched, and in another series heated to 500° quenched in water and annealed at 120–130°; Duralumin (3.95 Cu, 0.5 Fe, 0.05 Mg, 0.56 Mn, 0.12 Si); "German alloy," sand and die cast, (2.4 Cu, 11.22 Zn, 0.59 Fe, 0.14 Si); "American alloy," sand and die cast, (8.75 Cu and 0.47 Fe). Especial attention was given to the effect of the velocity of test from zero (static test) upward. The notch impact values were found to depend upon this velocity, increasing linearly with velocity except for the static values which were low. The percentage increase is characteristic of the property of the material tested. It changes with previous mechanical treatments but not with thermal. The static values are less than the dynamic and show no considerable influence of mechanical or thermal treatment. The notch impact value was found to be independent of the weight of the hammer; it increases with increased weight of the hammer only when this increased weight induces an increased velocity. The notch impact values of the Al alloys were found to be very small. The work is being continued. (6)

The Resistance of Steels to Abrasion by Sand. SAMUEL J. ROSENBERG. *Bureau of Standards Journal of Research*, Vol. 5, September 1930, page 553–574.

A study has been made of the adaptability of 3 types of apparatus, namely, the ball-mill, the sand blast and the Brinell machine, to the testing of the resistance of metals to abrasion. A detailed description of all apparatus used is given. The ball-mill was generally unsatisfactory; the sand blast gave consistent results but did not differentiate between the materials tested, apparently because of the fact that the abrading conditions were not sufficiently severe; but the Brinell machine proved to be generally satisfactory. The Brinell test showed that the resistance to wear of normalized, annealed, hardened or tempered carbon steels increases with their hardness. Increasing the temperature of annealing resulted in a slight increase in resistance to wear, the increase being more marked in a low-C than in a high-C steel. Abrasion in this type of test is caused by the gradual breaking up of the individual grains and not by the removal of separate grains in their entirety and this action is accompanied by local strain hardening. (6)

The Testing of Sheet Metal. *Metallurgist*, Sept. 1930, pages 139–141.

The testing of sheet metal by the ordinary tensile test is very difficult due to the tendency to tear rather than to produce a true tensile rupture. Ductility which is especially important in sheet materials is generally determined by bending tests which are open to the objection that either the piece is subjected to tensile stress at the time of bending or the repeated bendings do not take place at the same place. The cupping test which has been devised to overcome these difficulties is itself open to objection because of the large amount of friction between the plunger and the sheet introducing complicating features and the fact that, since the point of cracking is determined by visual inspection, an expert operator is required. Machines replacing the plunger by liquid have, therefore, been devised. These attempt to eliminate the friction between plunger and sample and the indication of failure is given by the escape of liquid and a sudden fall in pressure. Such a machine reported by Ch. Jovignot in the August number of the *Revue de Metallurgie* is described. The details of the machine as given are inadequate.

On the Influence of Small Deformations on the Physical Properties of Chains and Chain Materials. (Ueber den Einfluss geringer Verformungsgrade auf die Festigkeitseigenschaften von Ketten und Kettenbaustoffen.) W. PÜNGEL. *Stahl und Eisen*, Vol. 50, Sept. 11, 1930, pages 1297–1301.

Contains 3 references. Report of the Research Institute of the Vereinigten Stahlwerke, Dortmund, Germany. The results of an investigation on the influence of small deformation of chain steels on its sensibility for aging are as follows: A premanent deformation of 2–4% of the length of a chain link occurs when wrought iron chains as well as steel chains are stretched at 12 kg./mm.², according to the normal test procedure. This permanent deformation is due to the unfavorable section modulus in the bend of the chain link for bending stresses. The sensibility for aging is essentially increased for basic steel after small deformations from 1–4%. This holds for both the stretched and tempered (aged) state of the materials. Annealing is necessary. Annealing temperatures of 950–1000° C. are most suitable. An annealing at 700° C. tends to show up recrystallization even for these small deformations. Annealing at 1100° C. endangers the materials due to burning. Chains should always be annealed after the performance of the prescribed stretch test. Since the actual stresses of 5–7 kg./mm.² during the use of chains lead to permanent deformations, aging and brittleness occur after a certain time of use. It is advisable, therefore, to anneal used chains once a year at 900° C. Recommendations are furthermore made as to the development of more favorable shapes of chain links. GN(6)

The Testing of Materials in France. *Metallurgist*, June 1930, pages 84–85.

A critical review of a paper by M. P. Nicolau on "Some Recent Advances in Methods of Controlling Metallurgical Products" appearing in the Feb. issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* which is interesting because of its comparison of French thought with that of other countries. Apparently the French are entirely oblivious of work accomplished or conclusions obtained in any country except their own. The entire question of fatigue and corrosion fatigue is completely ignored and cases that are evidently those of true fatigue failure are ascribed to "fissuration" initiated either by a pre-existing crack or flaw or brought about by failure of the material to stand shock. Other cases are cited and the need of dissemination of American, British and German work into French thought to the mutual advantage of both is emphasized. VVK(6)

Cold Working and Young's Modulus. *Metallurgist*, Aug. 1930, pages 115–116.

Some recent work on Young's modulus by Mr. Tadashi Kawai in *Science Reports of the Tokohu Imperial University, Japan*, Series I., Vol. 19, no. 2 is abstracted somewhat in detail. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. VVK(6)

Fatigue and Impact Tests for Welds. CHAS. H. JENNINGS (Westinghouse Electric & Mfg. Co.). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 90–104. 13 references.

Reviews results obtained by various investigators on fatigue test for butt and fillet welds and impact tests of welds. Tests made by author were confined to arc welds and deposited arc weld metal. Annealing temperatures up to 1550°F. do not appreciably affect the impact strength of the welds. For annealing temperatures of 1550° and 1700° F. the impact strength is greatly reduced. These tests definitely show change in properties of the material that would not be shown by ordinary static tensile tests. Stresses need for tentative standard for dynamic tests, particularly fatigue tests because of extensive use of welds in dynamic structures. Gives tables, diagrams and photographs. LFM(6)

New Fatigue Machines with Swinging Test Bar. (Neuere Dauerbiegemaschinen mit schwingendem Probestab.) G. V. HEYDEKAMPF. *Metallwirtschaft*, Vol. 9, April 11, 1930, pages 321–326.

Contains 10 references. A new fatigue testing machine using a swinging test bar with either fixed or variable load is described, as distinct from the usual type with rotating test bar and constant load. It duplicates the action of automobile springs and airplane parts. Details of the apparatus and test bar are given. CEM(6)

Destructive and Non-Destructive Tests of Welds. A. B. KINZEL & J. K. DAWSON (Union Carbide & Carbon Res. Lab., Inc.). *Mining & Metallurgy*, Vol. 11, June 1930, pages 308–313.

Describes the various destructive and non-destructive tests that are in use and methods of carrying them out. Tensile testing of welds consists of producing failure in the specimen by applying a measured load. The latest bend test developed is known as the quantitative free bend test. The performance of the material in bending is measured by the amount of stretch in the outer fibers at the instant of failure. Fatigue and Izod tests are rarely applied in routine testing of welds. Another test used in research but not suitable for routine application consists of a hardness exploration of weld and adjacent base metal. Usually carried out with a Rockwell cone tester. The first non-destructive test applied to welds was the hydrostatic test. X-ray and stethoscopic testing are the most practical for non-destructive testing. See *Metals & Alloys*, Vol. 1, March 1930, page 427. VSP(6)

The Influence of Cross-Sectional Holes on the Endurance Limit. (Der Einfluss von Querbohrungen auf die Biegungsschwingungsfestigkeit.) HILMAR DÖRING. *Metallwirtschaft*, Vol. 9, Sept. 19, 1930, pages 781–786.

Contains 5 references. Holes 7.2 mm. diam. drilled transversely through bars 24 mm. diam. lower the endurance limit from 59 to 72%. 2 or 4 holes were drilled through the test pieces at various distances from the middle. Punched holes are slightly better than drilled holes, but the formation of ridges must be avoided. Grinding the holes is no improvement on account of the danger of cracking. CEM(6)

Progress in the Theory of Ferro-magnetism. (Fortschritte in der Theorie des Ferromagnetismus.) W. HEISENBERG. *Metallwirtschaft*, Vol. 9, Oct. 10, 1930, pages 843–844.

A review and discussion of 9 references covering the progress during the last 15 years. CEM(6)

Tensile Properties of Rail and Other Steels of Elevated Temperatures. J. R. FREEMAN & G. W. QUICK. Condensed by Richard Rimbach. *Metals & Alloys*, June 1930, pages 556–558; *Iron & Coal Trades Review*, Vol. 120, June 13, 1930, pages 947–948.

An extended abstract. Special study was made of rail steels and some other steels in the approximate temperature range of 400–700° C. It is shown that ductility decreases with increase in temperature over a portion of this range. This range is termed the "secondary brittle" range to distinguish it from the "blue brittle" range occurring at 200–300° C and the "hot short" range which is usually associated with the A_3 transformation and high sulphur content. The degree of secondary brittleness varies markedly between individual heats and the temperature of maximum effect also varies. It is shown that this phenomenon is not confined to individual rails or ingots but apparently is a property of the heat as a whole. The cause of the phenomena has not been determined. A hypothesis as to the formation of shatter cracks in rails, based on the phenomenon of secondary brittleness and temperature distribution during cooling, is presented. See *Metals & Alloys*, Vol. 1, June 1930, page 565. ESC + RHP(6)

Bending Tests of Metal Monocoque Fuselage Construction. R. W. MOSSMAN & R. G. ROBINSON. *N.A.C.A. Technical Note* No. 357, Nov. 1930, 40 pages.

The monocoque fuselage is a thin shell with a modified elliptical section. It may be designed with or without a reinforced skin. Airplane designers are seriously studying this type of construction as it has very good aerodynamic properties. The stresses in the skin for various materials have not been determined except for special designs. The authors proposed to develop a rational formula for non-reinforced structures and tested 3 cylinders 36″ in length bv 36″ in diameter and a wall thickness of 0.014″, 0.022″ and 0.032″, respectively. The cylinders were made of heat treated duralumin. There was no longitudinal reinforcement. There was one flanged U ring at the middle and an angle riveted at each end to give lateral support. The cylinders were supported, for testing, at one end by bolting through the angle to a backboard. They were loaded as cantilevers and failed by buckling on the compression side. The stresses calculated from the standard beam formula $p = \frac{Mc}{I}$ were 2150, 3890 and 5570 lbs./in.² for the wall thicknesses of 0.014″, 0.022″ and 0.032″, respectively. The authors also calculated the stresses by using a modification of Bazier's formula which gives the allowable stress in terms of the ratio $\frac{\text{Diameter of Cylinder.}}{\text{Wall Thickness}}$. This formula is maximum stress $= \frac{6600000}{D/t}$. These values were 2567, 4034 and 5867 lbs./in.², respectively for the 3 cylinders. The authors are in favor of adopting the latter formula for design as they believe it to be more applicable to structures which are unstable elastically.

These tests must be considered preliminary to more extensive investigations as the maximum stresses can be greatly increased by the use of longitudinal stiffeners without a proportionate increase in weight, and their effect must be determined empirically. JBJ(6)

Metal Covering of Airplanes. J. MATHAR. *N.A.C.A. Technical Memorandum* No. 592, Nov. 1930, 20 pages.

Mathar's article (original in Jahrbuch 1929 der Wissenschaftlichen Gesellschaft für Luftfahrt) is a very brief résumé of a series of experiments on the effect of shear loading on thin plate (0.008″ thickness) with a relatively large ratio of $\frac{\text{Length}}{\text{Height}}$ and with and without stiffeners. The Memorandum contains a theoretical discussion by Prof. H. Wagner on the relationship between stresses and deformation on buckled plate with variations in the spacing of the stiffeners. The paper is limited in scope and it is doubtful if the data could be applied to a practical design problem. JBJ(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Plating of Rolled Zinc and Zinc Base Die Castings. E. A. ANDERSON & C. E. REINHARD. *Metal Industry* (London), Vol. 37, July 25, 1930, pages 85–86, 88; Aug. 1, 1930, page 110; *Brass World*, Vol. 26, Feb. 1930, pages 39–41.

Lays stress on certain modifications of well known practice which simplify the production of plated coatings of Zn and emphasize the importance of cleaning. Gives formulae for Ni, Ag, Cd, etc. plating. The out-door exposure test is probably the only valid test of endurance of plated coating in service. VSP(7a)

The Cavity Scale for Measuring Throwing Power. L. C. PAN. *Metal Industry* (N. Y.), Vol. 28, June 1930, pages 271–274.

The cavity scale takes into consideration the electro-magnetic effect, gas film interference, cathode polarization, solution resistance and primary current distribution ratio. Applicable to all types of plating solutions. The scale is made from a metal bar with cavities of various depth representing recesses in articles commonly handled in plating shop. Gives mode of operation and its advantages. Includes historical review of throwing power measurement. VSP(7a)

Protective Value of Some Electrodeposited Coatings. L. DAVIES & A. WRIGHT. *Journal Institute of Metals*, Vol. 43 (1930), pages 247–269.

Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 797. (7a)

Practical Difficulties Associated with Electrodeposition of Chromium. J. W. CUTHBERTSON. *Metallurgia*, Vol. 2, Oct. 1930, pages 208–209; *Metal Industry* (London), Vol. 37, Oct. 31, 1930, pages 421–423; *Chemical Trade Journal*, Vol. 87, Oct. 17, 1930, pages 371–372; *Chemical Age*, Vol. 23, Nov. 1, 1930, *Metallurgical Section*, pages 25–26; *Brass World*, Vol. 26, Dec. 1930, pages 325-326.

Directions for avoiding some difficulties frequently encountered. Contains 2 references. JLG + WHB(7a)

Throwing Power in Chromium Plating. H. L. FARBER. *Metal Industry* (London), Vol. 36, April 4, 1930, pages 389–390.

A summary of report on the research at the Bureau of Standards. See *Metals & Alloys*, Vol. 1, April 1930, page 474. VSP(7a)

Chromium Plating. E. J. DOBBS. *Metal Industry* (London), Vol. 36, April 18, 1930, pages 435–436; *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 995–997, 999.

Paper read before Sheffield Trades Technical Societies, April 4, 1930. Present Cr solutions are made up from H_2CrO_4, together with certain conducting salts. For bright deposits H_2SO_4 is usually added. Pb anodes are used. Recommends a thick coating of Ni with a thin coat of Cr. Thickness of Ni sub-coating depends on nature of base metal. Adherence of plating. Anodes and vats are considered. VSP(7a)

Electroplating Research Progress. *Metal Industry* (N. Y.), Vol. 28, May 1930, pages 230–231.

A report of the Electroplating Conference held at Rochester, N. Y., March 22, 1930 under the auspices of American Electroplaters' Society and U. S. Bureau of Standards. First session was devoted to industrial plating of automobile and aircraft parts, hardware and silverware. The second session was devoted to reports from research laboratories. The third session to research fund and plans. VSP(7a)

Determination of the Thickness of Chromium Plate. *Metal Industry* (London), Vol. 36, June 6, 1930, page 604.

The General Testing Laboratories, Inc., Detroit devised a method whereby thickness of Cr deposits may be determined. Describes test briefly. VSP(7a)

Nickel Plating for Mass Production. *Brass World*, Vol. 26, Oct. 1930, pages 261–263.

An abstract of a paper read before the Electroplaters' and Depositors' Technical Society by N. R. Laban. The work was roughly classified as low-current density—up to 25 amps./ft.^{2}; medium, 25–50 amps./ft.^{2}; and high—above 50 amps./ft.^{2} High current density affords a more satisfactory deposit as regards mechanical properties as well as greater output. Advantages and disadvantages of the anodic cleaner and the importance of efficient swilling and draining are pointed out. WHB(7a)

Chrome Plating. *Industrial Chemist*, Vol. 6, May 1930, page 193.

A brief note on the dangers involved in chrome plating with suggested precautions. MPB(7a)

The Electrodeposition of Zinc on Aluminum and Its Alloys. H. C. COCKS. *Metal Industry* (London), Vol. 36, April 4, 1930, pages 385–386, 388.

Condensed from a paper read before the Electroplaters' and Depositors' Technical Society, Mar. 26, 1930. Based on results of investigations on the influence of a number of addition agents on the cathode potential and on nature of deposit. Deposits which afforded a good protection from corrosion to Al and Al alloys were obtained from $ZnSO_4$ and $Zn(CN)_2$ baths. Preparation of metal for plating. Result obtained with $ZnSO_4$ solution at pH value within range of 3.0 to 6.0 showed that in general, best results can be had when pH of solution is 4.0. By using moving cathodes a higher current density can be used without freeing of deposits and it tends to sweep off adhering bubbles of air or H and thus diminish formation of gas-pits. Experiments showed that satisfactory deposits of Zn on Al can be obtained from several solutions. All deposits from sulphate baths gave good protection for Al alloys but ammoniacal Zn $(CN)_2$ baths have not. Gum arabic in sulphate baths is recommended. VSP(7a)

New Methods of Electroplating. (Neue Methoden in der Galvanotechnik.) W. PFANHAUSER. *Metallwirtschaft*, Vol. 9, June 13, 1930, pages 506–508.

A review of the progress during the last few years. Better results are now obtained with shorter plating time, for instance in Cu and Ni plating, and with more concentrated electrolytes. The use of higher cathode current densities, agitation of the solution, smaller baths, relation of anode to cathode surface and the use of colorimeters for quick analysis are discussed. The advent of Cd and Cr plating, salt spray test, cleaning of metals prior to plating and continuous automatic plating processes described. CEM(7a)

Electrometallurgy (7b)

Ontario Refining Company—Electrolytic Copper Plant at Copper Cliff Has Novel Features. E. D. LONEY. *Canadian Mining Journal*, Vol. 51, Mar. 28, 1930, pages 294–296.

The building construction, the tank house and power supply, and the precious metal refinery are outlined and the novel features of the plan pointed out, i. e., plant design is such that it can be easily expanded to take care of double the initial capacity, and the copper has a straight line flow from the blister storage building to the wirebar storage building, where refined copper will be loaded into cars for shipment. Permanent operating crews will probably be employed about midsummer of 1930. WHB(7b)

Silver-Producing Mines of British Columbia. L. V. EARDLEY-WILMOT. *Canadian Mining Journal*, Vol. 51, Feb. 7, 1930, pages 134–135.

Almost all of the silver produced in British Columbia is obtained from silver minerals associated with lead and zinc minerals or less frequently with copper or gold. Most of the ores and concentrates are treated in the Consolidated Mining & Smelting Company's plant at Trail where about 8,000,000 oz. of pure silver bullion are refined annually. WHB(7b)

A New Electrolytic Zinc. F. S. ELFRED, JR. (Evans-Wallower Zinc Co.) *Metal Industry* (N. Y.), Vol. 28, May 1930, pages 223–224.

Read before the Chicago Meeting of the American Die Casting Institute Jan. 1930. Discusses briefly the history and methods of extraction of Zn. The latest method of Zn production is known as Tainton Electrolytic Zn process. Gives a detailed description of the process. VSP(7b)

Electrolytic Iron. (Il Ferro Elettrolitico.) R. B. DAPNIS. *La Metallurgia Italiana*, Vol. 22, Sept.-Oct. 1930, pages 855–869.

General résumé of the subject, with 20 references. Nine photographs are shown of an electrolytic iron plant, designed to produce 800 tons of finished tubing and sheet per year, located at Pont Saint Martin, Italy. This plant utilized the Bouchayer process, similar to that previously installed at Grenoble, France, using cast anodes, but was expected to try out the Eustis and Perrin process for the leaching of pyrrotite or pyrites cinder with $FeCl_3$ and electrolysis of the resulting $FeCl_2$. The plant, however, only ran 6 months, and the company was liquidated. The energy consumption per kilogram of iron produced was 4.5 kwh. It was concluded that the electrolytic iron industry involved no especial technical difficulties, but in peace time has no economic reason for existence. The experience gained is thought to be of value for Italian war-preparedness, since Italy lacks domestic copper for cartridge cases, driving bands for projectiles, etc. for which annealed electrolytic iron might be substituted. HWG(7b)

Electrolytic Production of Metals. (Le developpement et la production electrolytique des metaux.) *Journal du Four Electrique*, Vol. 39, July 1930, pages 256–258.

A survey of electrolytic production of metals taken from the data of T. H. Donahue. JDG(7b)

Preparation of Metal Powders by Electrolysis of Fused Salts. I. Ductile Uranium. F. H. DRIGGS & W. C. LILLIENDAHL (Westinghouse Lamp Co.). *Industrial & Engineering Chemistry*, Vol. 22, May 1930, pages 515–519; *Metal Industry* (N. Y.), Vol. 28, May 1930, page 226.

Presented before the Division of Industrial and Engineering Chemistry at the Atlanta Meeting of the American Chemical Society, Apr. 1930. Bibliography of 17 references. Uranium metal powder was prepared by electrolysis of potassium uranous fluoride in fused calcium and sodium chlorides. The powder was fused to a coherent mass in an evacuated high-frequency induction furnace. Chemical analysis of the metal showed C 0.06%, Fe 0.05% and Si 0.01% as the only impurities. Chemical and physical properties of uranium are listed. MEH + VSP(7b)

Electrolytic Copper Refining. FRANK R. CORWIN & CARLETON S. HARLOFF. *Metal Industry* (London), Vol. 36, June 13, 1930, page 632.

Abstract of paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 797. VSP(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Flux Spots and Tin Oxide Blots. WALLACE G. IMHOFF. *Metal Industry* (N. Y.), Vol. 28, July 1930, page 333.

Flux spots on retinned milk and ice cream cans are caused by failure to thoroughly clean the cans, and also to flux which is dirty and contains foreign matter. Tin oxide blots suggest that flux is not in good condition. Pure zinc chloride should be used as flux. Tin bath should be well boiled before starting operations. After cans are removed from pickle, they are to be dipped in liquid tinning flux. Tin pot should be kept clean of tin-dross. VSP(8)

Protection of Iron and Steel by Metal Spraying. *World Power* (London), Vol. 13, Jan. 1930, pages 65–66.

The metallization of iron and steel consists of spraying with aluminum or a similar coating with a view to protection from attack by oxygen at rather high temperatures. The method of metal coating is discussed. (8)

The Destructive Action of Molten Zinc, at and Above Zincing (Galvanizing) Temperatures, upon Metals and Alloys. XI. The Action upon Non-Metallic Materials—General Summary. WALLACE G. IMHOFF. *American Metal Market*, Vol. 37, Oct. 21, 1930, page 11.

A thermometer casing was coated with vitreous enamels and tested in the galvanizing bath. From a commercial standpoint vitreous enamels gave the highest resistance to the action of molten zinc under galvanizing conditions. A complete summary is made in 23 subdivisions, and it is concluded that nothing has been found so far that will entirely withstand the corrosive action of molten zinc at galvanizing temperatures. WHB(8)

Cadmium as a Protection Against Corrosion. A. SIEMENS. *Metal Industry*, (London), Vol. 36, May 2, 1930, pages 481–483.

Translated from *Zeitschrift für Elektrochemie*, Vol. 36, page 110. Cd is used as protective coating for automobiles, aeroplanes, electrical and photographic materials, domestic articles, steel springs, etc. Coating can be produced by dipping material in liquid Cd at 360–380°C. or by application of liquid Cd at 350° C. by means of steel brush. Spraying the liquid metal is also used. Most widely used method is the electrolytic deposition of Cd, from its potassium cyanide complex salt solution. To deposit Cd in a very dense non-porous and bright form, colloids are often added to bath, such as wood fiber, shellac, casein, etc. Cd baths have very good throwing power. Cu is easily coated with Cd, while pure Al requires preliminary treatment. Cd alloys may be prepared electrolytically as protective coatings. VSP(8)

On the Diffusion of Cobalt, Nickel and Chromium into Iron in the Solid State. (Ueber die Diffusion von Eisen mit Kobalt, Nickel und Chrom in festem Zustande.) W. VAN DRUNEN. *Dissertation, Technische Hochschule Stuttgart* (1928), 34 pages.

The introduction of certain elements into the surface of metals and alloys plays an increasingly important role in metallurgy and resulted in processes of commercial significance. In the present quantitative experiments the author throws light upon the relationship between temperature, depth of penetration and concentration of the following systems: Fe-Co, Fe-Ni and Fe-Cr-Ni, by heating cylindrical rods of electrolytic iron in Co, Ni, Co + Ni powder at various temperatures in an atmosphere of hydrogen. The computation of the diffusion coefficients, however did not yield useful data values. The diffusion formula of Fick referring to aqueous solutions does not hold for the crystalline solid state. Corrosion resistant layers could be secured on the surface of Fe corresponding to the composition of standard Cr-Ni steels. EF(8)

The Determination of the Coating of Galvanized Sheet Steel. CHARLES O. GEYER & BENJAMIN E. COHN. *Chemist-Analyst*, Vol. 19, Sept. 1930, pages 4–5.

Two new methods are described. The weighed and measured sample is placed in a beaker in contact with a piece of zinc and covered with 1:10 H_2SO_4 or 1:5 HCl. After 5–10 min. the acid is poured off and the sample washed. Contact with Zn prevents acid attack on the steel. The second method consists of protecting the steel with an organic inhibitor such as "B.B. Inhibitor" or "Red Seal Inhibitor." The sample is immersed in warm acid containing the inhibitor until no more gas is evolved. The protection is not quite complete. CEM(8)

INDUSTRIAL USES & APPLICATIONS (9)

Making High-Pressure Steel Drums in Germany. *Iron Age*, Vol. 126, July 24, 1930, pages 232–233.

Describes construction of high-pressure drums for chemical and other industries by the August Thyssen Hütte Gewerkschaft, a subsidiary of Vereinigte Stahlwerke, A. G. Düsseldorf. The steel is of 50,000 to 64,000 lbs./in.^{2} tensile strength and is best treated during fabrication of drums. They are tested at 350 atmsopheres. Tendency to resist corrosion is claimed as drums are not machined. Ordinary open-hearth steel is used. Made in thicknesses up to 9 mm. and 1700 mm. outside diameter. VSP(9)

Uses of Zinc. *Industrial & Engineering Chemistry*, Vol. 22, May 1930, page 548.

A note citing some of many uses to which this metal is put. MEH(9)

Journal Bearing Practice. FRANCIS HODGKINSON. *Proceedings Institution of Mechanical Engineers*, No. 5, 1929, pages 843–859. Discussion, pages 860–881.

Deals almost entirely with the problem of lubricating the bearing but gives specification for the type of bearing used and properties of metal. RHP(9)

Chromium-Copper Structural Steels. J. A. JONES. *Iron & Coal Trades Review*, Vol. 120, May 2, 1930, pages 718–719.
Abridged from a paper before the Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 799. RHP(9)

Aluminum Alloys for Aircraft-Engine Piston and Cylinder Heads. A. J. LYON. *Transactions American Society Mechanical Engineers, Aeronautical Engineering*, Vol. 2, Oct.-Dec. 1930, pages 257–269; *American Machinist, European Edition*, Vol. 72, July 26, 1930, page 996.
The paper contains results of a great amount of valuable research on aluminum alloys for aircraft-engine piston and cylinder heads that has not heretofore been covered, and the findings should be valuable to all aircraft engine designers. Two alloys have heretofore been recommended, but the Material Division at Wright Field has developed a series of new alloys, and the paper describes the method of manufacture, the effect of numerous alloying constituents on their properties, the strength at elevated temperature, their stability, and the methods of heat treatment, with comparison with the present standard alloys. (9)

Industry's Metals Enter the House. E. C. BADEAU. *Brass World*, Vol. 26, Feb. 1930, pages 31–32; *Sheet Metal Worker*, Vol. 21, Sept. 5, 1930, pages 531–541.
Monel metal is being used more and more in household appliances, particularly for kitchen equipment, fire-places, mantle pieces, radiator covers, lighting fixtures, etc. WHB(9)

Wear and Tolerances on Gages. E. J. BRYANT. *S.A.E. Journal*, Nov. 1930, pages 553–556.
Alloy steel which can be hardened uniformly is recommended as material for gages. Chromium-plating is criticized because it is not bonded to the base material, and tungsten carbide is recommended for some gages in which the wear is extreme. (9)

Iron and Steel for Underground Supports. J. S. CARSON. *Iron & Coal Trades Review*, Vol. 120, June 127, 1930, page 1030.
Abstract of a paper before the Mining Institute of Scotland, Edinburgh, June 21, 1930. Discusses the subject from the mining standpoint. Steel would be cheaper, take less space in shallow seams, last longer, be safer and permit more regular output of coal due to infrequency of falls. RHP(9)

Possibilities of Malleable Iron Castings. W. J. MOLINEUX. *Metallurgia*, Vol. 2, May 1930, pages 7–8.
Small malleable iron castings of intricate design can be cheaply produced. Such castings have the properties of mild steel and are suitable for many engineering uses. Competitive materials are forgings, steel castings and non-ferrous castings. If use of malleable iron is to be extended the quality of castings must be maintained and the costs reduced. Modifications in the annealing process offer the most promise in reducing costs. The short annealing method developed in America and used by the Canadian General Electric Co. is briefly described. JLG(9)

Light Car Engine Pistons. Some Points to Bear in Mind. BASIL BARHAM. *Metal Industry* (London), Vol. 37, July 18, 1930, page 52.
Use of Al for pistons brought about new problems. Al expands more than cast Fe. Al pistons when cold easily fit cylinders, but swell and bind as soon as engine begins to work. Al pistons are made much smaller than cast Fe, consequently at low temperatures, there is a tendency to knock. Piston slap has been cured by use of thicker oil, but in warm weather and on lengthy runs oil has tendency to thin. The matter is up to the designer and manufacturer. VSP(9)

Metal Furniture Output Expanding to Meet Wider Popular Appeal. LOUISE BONNEY. *Iron Age*, Vol. 126, July 10, 1930, pages 75–77.
Development of new alloys in Al and steel has opened new fields to the metal worker. Metal furniture is of outstanding interest since it offers mass production possibilities. Al, rustless steel, monel metal and steel or brass, Cr plated or enameled, are used for furniture. High cost of production will be lowered. Greatest success will come to metal which offers most resistance to the elements. Several companies are now in the field. VSP(9)

Lengthening Rails by Butt Welding. L. C. RYAN (Oxweld Railroad Service Co.). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 133–141.
Describes process developed for eliminating joints by means of butt welding. Wear of rail ends by battering is eliminated increasing life of rail. Rail creeping is also done away with resulting in great economy. A continuous rail would provide perfect conductor for signal currents without use of the bond. LFM(9)

Constructing Fuselages for Airplanes. E. F. LAKE. *Machinery*, Vol. 36, May 1930, pages 702–708.
Fuselages must be light but strong to support the rest of the plane equipment and to withstand vibration. All joints are welded. An alloy steel fuselage weighing 237 lbs. is equal in strength to a carbon steel of 400 lbs. Chrome-molybdenum is the alloy used by the Buhl Aircraft Co. Duralumin is not as good as steel for this work. RHP(9)

Sheath Wire. F. E. FINDLAYSON (General Electric Co.). *American Machinist*, Vol. 71, Sept. 12, 1929, pages 445–448.
Sheath wire units consist in general, of five parts, the sheath, the coiled resistor, the "cold" terminals, and the insulation. Their maximum temperature is about 1000°F. The units are made by winding a helix of nickel-chromium resistance wire of proper size and length, and attaching the "cold" terminals which are heavy nickel wire. This resistor is inserted in a tube of material suited to act as a sheath. This is filled with finely powdered magnesium oxide and then is reduced in diameter by swaging. This process compresses the magnesium oxide till it is very hard. In this state it is a fairly good conductor of heat but is still an electrical insulator. Discusses the industrial applications. RHP(9)

The Use of Noble Metals for Chemical Apparatus and Laboratory Ware. (Edelmetalle für chemische Apparate und Laboratoriumsgeräte.) J. SPANNER & L. NOWACK. *Metallwirtschaft*, Vol. 9, June 13, 1930, pages 510–512.
The effect of chemicals on Pt, Ir, Pd, Au and Ag are discussed. The use of Pt in the laboratory. Pure Pt is too soft, it can be alloyed with Ir, Rh, Pd, Os or Ru. Pt substitutes consist of Au-Pd alloys or Au + 10 to 15% Pt. Pt is used for electrodes, electrical contacts, in the silk industry and in chemical plants where the purity of the product is essential. Alloys of Ag with Cd and Zn have recently been used. Ag Alloys are used as solder. CEM(9)

Sheet Steel and Strip Steel for Automobile Bodies. JOSEPH WINLOCK & GEORGE L. KELLEY (E. G. Budd Mfg. Co.). *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 147–178.
A paper presented before the Semi-annual meeting in New York, Feb. 7–8, 1930. Includes discussion and 44 references. A steel of less than 0.14% C, 0.60% Mn, 0.045% S and P is specified for this work. Alloys have only been used in exceptional cases. Rigidity is obtained by designing the stamping to have high section modulus. The inherent defects in such steel from the melting and rolling and annealing operations are mentioned including ingot segregation, "laminations," and large grain size. Methods of manufacture are briefly discussed. Hot working, cold working of sheets, "stretcher strains" from forming operations and annealing methods are discussed at length. Critical grain growth and decarburization in annealing are discussed. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 691. WLC(9)

Steel Forgings in Design. LAWFORD H. FRY. *Machine Design*, Vol. 2. Sept. 1930, pages 38–41; Oct. 1930, pages 27–31; Nov. 1930, pages 38–40.
Part I briefly discusses basic and acid open hearth processes of steel production and solidification of ingots. Part II deals with the production and heat treatment of forgings. Part III discusses physical properties of steel forgings, also some data on characteristics of a number of alloys. (9)

Manufacture and Application of "Y" and "RR" Alloys. W. C. DEVEREUX. *Nickel Bulletin*, Vol. 3, Sept. 1930, pages 286–293; *American Machinist* (European Edition), Vol. 73, Sept. 27, 1930, pages 77–78.
The manufacture and application of these aluminum alloys are dealt with. See *Metals & Alloys*, Vol. 1, July 1930, page 626. (9)

Aluminum for Threaded Parts. J. D. PORTER. (Aluminum Company of America.) *American Machinist*, Vol. 72, May 8, 1930, page 762.
To prevent seizing of threaded aluminum parts there are 3 methods available. If looseness is not objectionable, a small amount of play may suffice. If a tight fit is necessary, an "anti-seize" compound in the form of paste will be required. This will have to be replaced at each re-assembly. Electroplating of zinc on one of the threaded surfaces will minimize the trouble to an even greater extent and does not require replacement at each separation. RHP(9)

Employing Monel Metal for Machine Parts. E. C. BADEAU. (International Nickel Co.) *Machine Design*, Vol. 2, Oct. 1930, pages 36–38.
The use of Monel metal for machine parts is briefly discussed. Tables give physical and mechanical properties. (9)

Industrial Magnetic Materials for Steady Fields. A. M. ARMOUR. *Electrician*, Vol. 105, Sept. 12, 1930, pages 304–307.
A study of iron and its alloys, heat treatment, output of permanent magnets and cobalt steel castings. Magnetic materials used in industry are classed as: (1) those working under alternating or cyclic changes of magnetization; and (2) those which experience mainly steady conditions of magnetization. This paper deals solely with the latter class. Low-carbon (0.15% C) steel castings are used for stationary parts of dynamo electrical machinery, 0.30% C steel is used for spiders and pole end pieces, and cast iron is used where cost is more important than mechanical strength. Steel forging in the rotating field systems of turbo-alternators, and mild steel for bars and rods. Nickel-iron alloys and special alloys such as monel metal, and Heusler's alloy (14% copper) are used for special purposes. Non-magnetic alloys are used chiefly in alternating fields where their lower permeability give a smaller energy loss than magnetic materials. Cobalt steels of 35% cobalt content are replacing tungsten steel magnets. Steels containing 9% and 15% cobalt, respectively, are sometimes used. Cobalt steel materials require a greater magnetizing force than tungsten steels to obtain maximum magnetic properties. WHB(9)

Wires, Strands and Ropes in the Construction of Aeroplanes. (Drähte, Litzen und Seile im Flugzeugbau.) MARTIN ABRAHAM. *Luftfahrtforschung R. Oldenbourg Verlag*, Vol. 7, May 6, 1930, pages 73–136. Price 13.20 RM.
First, the conception, kind of application and standardization, so far accomplished for wires, strands, and ropes for the particular use in aeroplane construction are explained; the strength of the 3 forms of material are discussed and the different kind of joints and connectors are described in detail. Further elongation and elasticity, torsion under load is treated and testing methods and results described. Tension and its measurement, life of the 3 forms, statistics of accidents, arrangement of guide rolls, and in conclusion, corrosion and surface protection are discussed and some remarks added to replace these elements by other construction elements, for which in particular steel bands are recommended. The whole paper is richly illustrated and very instructive; numerous references are given and a very useful table of comparison of German, English, French and American Standards added. Ha(9)

High-Power Thermal Engines and Materials. (Grossleistungs Wärmekraftmaschinen und Werkstoffe.) A. THUM. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, June 14, 1930, pages 798–804.
Paper read at the Second World Power Conference in Berlin. In order not to sacrifice safety of operation with modern engines of high power and highest pressures by failures of the material, the usual constructive design based on static values of strength and ample margin of safety no longer suffices. The true reasons for engine failures and fractures must be found and examined. Among these failures are notch-actions which considerably reduce the fatigue strength with alternating and impact stresses; further aging phenomena, faulty material, too low heat-strength, interior stresses and heat stresses. For heat power engines, high-grade pearlite castings must be used, rust-proof steels for nozzles of steam turbines, aging-proof steels for the construction of large boilers. Suitable materials have also been found for explosion engines by systematic research and the danger due to interior and heat stresses could be reduced considerably. Systematic research made it possible to obtain steam turbines to-day with one shaft for 50,000 KW at 3000 RPM and more than 100,000 KW at 1500 RPM; one has succeeded in using safely pressures of 200 at. and steam temperatures of 500° C. Diesel engines can be built for 12,000 KW at more than 200 RPM. Ha(9)

Specialized Manufacture of Parts Aids Small Airplane Builder. *Iron Trade Review*, Vol. 86, Feb. 13, 1930, pages 45–48.
Metal airplane parts such as wing ribs, compression members, ailerons, tail surfaces, bulkheads, and spars are being built by specialized manufacturing methods for small producer. Aerotrus Products Corp., Los Angeles, for example, uses a special high- or low-carbon sheet steel of thin gage, rolled into U-channel sections, in combination with a special trussing design and a new brazing method. A special bronze that melts at exactly the right temperature of the torch and metal being joined is used. Maximum brazing temperature is 1000° F. Government tests have showed the joints to develop the full strength of the metal even after being subjected to 2850 vibrations per min. for 48 hrs. Edward G. Budd Mfg. Co. has developed a wing-rib design, made up of steel Channel section, spot-welded. It has found a non-corrosive steel, of 200,000 lbs./in.^{2} tensile strength, which can be die-formed and electrically welded without selective corrosion or weakness. MS(9)

Advocates Electric Welding of Boilers. *Electrical World*, Vol. 96, Oct. 11, 1930, pages 694–696.
The Babcock & Wilcox Company recommends electric welding of boilers, based on the results of several hundred tests. Characteristics of welds were determined by X-ray and electromagnetic methods. The fusion welding process developed by the B. & W. Co. involves the use of a specially coated low-carbon steel electrode, special automatic and hand equipment for welding and special tests procedure for testing the completed weld. Two non-destroying tests are made. In one the X-ray photographic plant designed by the St. John X-Ray Service Corp. is used and in the other an electromagnetic flaw detector equipment developed in the B. & W. shops by the Sperry Development Co. Characteristics of the B. & W. fusion weld are tabulated and several photographs and photomicrographs shown. WHB(9)

Electrical Uses of Anodic Oxidation. *Metallurgist*, Aug. 1930, page 128.
The June issue of the house organ of the Vereinigte Aluminium Werke reports a new use of anodically oxidized aluminum. The aluminum oxide film formed by anodic oxidation appears to be an exceptionally good electrical insulator. Aluminum wire thus coated can, therefore, be used for carrying high voltages, for the winding of transformer coils and even for the coils of motors and dynamos. VVK(9)

HEAT TREATMENT (10)

Heat Treatment of Steel. (Tratmento termico del acero.) G. SOTO. (Fábrica Nacional de Trubia.) *Anales de la Sociedad Espanola de Fisica y Quimica*, Vol. 28, June 1930, Review Section, pages 129–152.

A general lecture on the fundamentals of heat-treatment, containing examples, data and micrographs from the metallurgical work at the Spanish Gun Factory. Data on Mo in NiCr steels show its effect on the critical points and depth-hardening. HWG(10)

Annealing & Normalizing (10b)

Single-Sheet of Thin-Pack Normalising or Heat Treatment versus Box-annealing of Sheets. R. WHITFIELD. *Sheet Metal Industries*, Vol. 4, July 1930, pages 185–190; Aug. 1930, pages 273–276; *Iron & Coal Trades Reviews*, Vol. 120, May 2, 1930, pages 714–716.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 800. RHP+AWM (10b)

Malleable Cast Iron. Part 4. J. V. MURRAY. *Metallurgia*, Vol. 2, Oct. 1930, pages 215–217.

Description of the annealing process for producing "whiteheart" malleable castings. JLG(10b)

Recent Developments in Normalizing Sheet Steel. EDWARD S. LAWRENCE (Duraloy Co.). *Transactions American Society Steel Treating*, Vol. 17, June 1930, pages 784–797; *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1455–1460; *Fuels & Furnaces*, Vol. 8, Feb. 1930, pages 191–194; *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 201–204.

Paper presented before the Semi-Annual Meeting of American Society for Steel Treating, New York City, Feb. 1930. Includes discussion. The paper discusses in general and chronological order several improvements in continuous sheet normalizing furnaces. The advantages of normalizing over box annealing are discussed and lie in shorter time, less fixed charges for equipment, and improved and more uniform quality. The requirements of the automotive industry for sheets of better quality for more intricate stampings have been met by this process. The old blue annealing furnaces have been adapted and improved by the use of better refractories, sectional construction, hearth insulation and the introduction of a conveyor system which has been subject to continuous improvements, making a workable continuous normalizing furnace for sheet steel. Accumulations of scale on the hearth have been greatly reduced by the use of alloy carrier sheets. Further elimination of scale accumulation without the use of carrier sheets is the object of further work which the author reports will soon be ready for publication. The heating cycle has been established to the satisfaction of the metallurgist and its mechanical features improved. A cooling zone has been added to the furnace and its mechanical features worked out to give any desired rate of cooling. The author states that this controlled cooling in the cooling zone will ultimately work out the complete elimination of any necessity for box annealing. In discussion, the author states that further improvements in the conveyors are in process of being worked out and that the economy of treating sheets in 3 hours instead of 3 days will come into its own with perfection of the cooling zone. MS+WLC(10b)

Structure Changes in Annealing Soft Steel. (Gefügeänderungen beim Glühen von weichem Stahl.) W. HEIKE & W. BRENSCHEIDT. *Archiv für Eisenhüttenwesen*, Vol. 4, Aug. 1930, pages 99–103; *Stahl und Eisen*, Vol. 50, Sept. 25, 1930, pages 1362–1363.

In annealing carbon steels in oxidizing atmosphere, the formation of large column-like crystals which grow from the edge to the center is frequently observed. In order to bring about this typical crystallization, the following conditions are necessary: Presence of C, presence of stresses and annealing in an atmosphere which picks up C. The column crystals appear only after having subjected the steel to slight deformations and a subsequent annealing for 3 to 5 hours at temperatures below the α-γ transformation point. The crystals grow larger after having continued the annealing at somewhat higher temperatures for 12–24 hours. As light deformation of not more than 1% is sufficient to start this crystallization at the mentioned heat treatment. A deformation of 3% is most favorable to bring about the effect whereas it disappears at a 6% deformation. The second part of the paper deals with the tendency of P to displace C and the influence which degree of deformation, temperature and annealing temperature exercise. In annealing between A_1 and A_3, C is displaced in the spots high in P, thus leading to a crystal growth after an annealing over a longer period which is due to the diffusion of P. GN(10b)

Case Hardening & Nitrogen Hardening (10c)

Nitriding Investigations. R. SERGESON. *Journal Society Automotive Engineers*, Vol. 26, Jan. 1930, pages 110–111.

Résumé of developments of nitralloy and the nitriding process. The results obtained by nitriding are compared with those obtained by carburizing, with consideration of the effects of various temperatures during the nitriding process. Furnaces, methods, and results are discussed. Nitriding is found to increase the strength of steel. (10c)

Structure of Steels Case Hardened in the Cyanide Salt Bath. (Gefüge im Zyanidsalzbad eingestzten Stahles.) W. HENNIGER & H JURICH. *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1334–1335.

Whereas former investigations on case hardening of steel in a cyanide salt bath could not prove the presence of nitrogen in the form of nitride needles or a nitrogen eutectoid, the authors were successful in revealing the presence of nitrogen in a low carbon steel which had been cyanide for 5 hours, by etching with a hot sodium picrate solution. GN(10c)

Annealing or Softening of Nitrided Steels by Chemical Decomposition of the Nitride. WILLIAM J. MERTEN. *Transactions American Society for Steel Treating*, Vol. 17, May 1930, pages 638–645.

Paper presented to the Semi-annual meeting of the Society in New York, Feb. 7–8, 1930. Includes discussion. A method of softening nitrided parts for remachining using a salt bath of equal parts of KCl and NaCl at temperatures about 1500° F. is given. The author suggests that the nitrides of the case are decomposed by the molten alkali chlorides to form a gaseous chloride of nitrogen. Micrographs are shown. Denitrided parts may be satisfactorily renitrided. The occurrence of denitriding when parts are exposed to gases of halide compounds in service is discussed. In discussion, the author states that the distortion in renitriding is no greater than in original nitriding. WLC(10c)

On the Carburization and Decarburization of Carbon Steels. TAKEJIRO MURAKAMI & HARUJIRO SEKIGUCHI. *Tetsu to Hagane*, Vol. 16, Oct. 25, 1930, pages 1015–1040.

On heating steels containing 4 different carbon contents, 0.29%, 0.70%, 1.02% and 1.29%, at 800°, 900° or 1000° C. with different packing materials, the conditions of carburization or decarburization of carbon steels were studied by the change of weight and of the microstructure of specimens, before and after the heating. When the carbon content in steels exceeds about 0.5%, the decarburization takes place at 800° on heating with charcoal powder, though it is not decarburized, if the temperature is higher than 900° or carbonate is mixed in the charcoal. If air penetrates through the packing material during heating, the decarburization is conspicuous. The carburization is markedly energized by adding Na_2CO_3 or $BaCO_3$. When the carbon content in steel is more than that corresponding to the A_{cm} point, the rate of carburization is very sluggish, even when a powerful carburizing agent is used. The presence of a small amount of moisture in the charcoal powder tends to promote the carburization, while the size of the powder seems to have practically no effect provided it is fine within a certain limit. TM(10c)

Quenching (10d)

The Quenching of Steel. *Metallurgist*, July 1930, pages 100–102.

An extended abstract of French's work on the quenching of steel published in the June Transactions of the American Society for Steel Treating. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 344. VVK(10d)

Aging (10f)

The Artificial Aging of Duralumin and Super-Duralumin. K. L. MEISSNER. *Engineer*, Vol. 150, Sept. 19, 1930, page 319.

Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. LFM(10f)

Question of Age Hardening Based on Experiences with Iron Alloys. (Zur Frage der Vergütung auf Grund der Erfahrungen mit Eisenlegierungen.) W. KÖSTER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Aug. 2, 1930, pages 1100–1101.

Paper read before Deutsche Gesellschaft für Metallkunde, dealing with a historial review, and a discussion as to which properties can be improved by a suitable heat-treatment. The etching effect and some chemical phenomena which are not quite elucidated are discussed Ha(10f)

Age-Hardening. MARIE L. V. GAYLER. *Metallurgist*, June 1930, pages 91–93.

If a supersaturated solid solution is formed in an alloy when it is quenched from a high temperature, and if the alloy is left at room temperature, or possibly at some higher temperature, then age-hardening may occur. The most important theory for this phenomenon is the "precipitation" theory. This theory attributes age-hardening to the precipitation, in a highly dispersed state, of particles from a supersaturated solid solution. The objections to this theory have been (1) lack of microscopical evidence of the presence of precipitated particles, and (2) the fact that age-hardening at room temperature is accompanied by an increase in electrical resistance, while aging at higher temperatures is accompanied by a decrease in electrical resistance; which, it is claimed, suggests that a process of solution takes place at room temperature, but precipitation at higher temperatures. The first objection has been removed by definite microscopic evidence of particles of the compound $CuAl_2$, which has been precipitated during the aging of a copper-aluminum alloy. X-ray investigation indicates that the crystal lattice is being severely distorted during the process of age-hardening, and that great stresses are being set up within the crystals. This is accompanied by an increase in electrical resistance. It is suggested that precipitation from the supersaturated solid solution takes place in two stages; (1) the rejection of the atoms of the dissolved metal from the lattice of the solid solution, accompanied by the possible formation of molecules, and (2) a "coagulation" of these rejected atoms or molecules, resulting in the formation of minute crystallites of a second phase. X-ray investigations on various alloys, examples of which are given, and changes in hardness and electrical conductivity supports this theory. The author concludes that the facts which have been established regarding the changes which take place during age-hardening are strong confirmation that hardening it due to the precipitation of highly dispersed particles. VVK(10f)

JOINING OF METALS & ALLOYS (11)

Brazing (11a)

Brazing Spelters. NEVILLE DEANE. *Metal Industry* (London), Vol. 36, May 23, 1930, page 559.

Gives method and mixtures used. VSP(11a)

Welding & Cutting (11c)

Training Course for Aircraft Welders. R. W. BOGGS (Union Carbide Co.) & S. C. CLARK (Linde Air Products Co.). *Journal American Welding Society*, Vol. 9, June 1930, pages 62–76.

Outlines training course for aircraft welders based on established principles of procedure control. Figures are given showing the shop work layout for each lesson. LFM(11c)

Welded Steel Structures. EDWARD DARCE LACY. *Metallurgia*, Vol. 2, Oct. 1930, pages 201–202.

Gives reasons why a welded structure is preferable to a riveted structure. JLG(11c)

Shrink-Stresses and Their Care in Arc-Welding. (Schrumpspannungen und deren Beachtung beim Lichtbogenschweissen.) LOTTMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 20, 1930, pages 1340–1345; *Elektroschweissung*, Nov. 1930, pages 205–214.

The causes of production and the conditions for the magnitude of shrinking in arc-welding are described and practical shrinking values are given in the form of a curve which can be used for working on large pieces of from 5–12 mm. thickness. The danger is pointed out of clamping a piece tightly when welding and the direction of tensile and compression stresses as a function of the rigidity of the piece, of direction and sectionalizing of welding is explained. In conclusion, practical directions are given for the selection of tools and how to proceed in order to limit shrinking stresses. Ha(11c)

A Fourteen-Story Office Building Field Arc-Welded in Boston, Mass. FRANK P. MCKIBBEN (General Electric Co.). *General Electric Review*, Vol. 33, Dec. 1930, pages 699–705.

The design, the erection, field welding, the qualification of welders, the inspection, and other data are discussed. WHB(11c)

Electric Welding by the Carbon Arc. J. C. LINCOLN. *Journal American Institute Electrical Engineers*, Vol. 49, Feb. 1930, pages 110–113.

The author discusses the butt welding of steel sheets by the C arc process. Autogenous welding is divided into 2 main classes; gas and electric. Electric arc welding is divided into 2 classes: metallic and C arc. Gas and metallic arc welding in general require beveling of plates for butt weld while C arc welding does not. The controlling variables in C arc welding are (1) amperes in the arc, (2) voltage across the arc, (3) magnetic field about the arc, (4) atmosphere about the arc, (5) speed of feed and (6) filling-in material. Discussion is given of the effect of each of these variables of the resulting weld with special reference to the action of a magnetic field parallel to the direction of the arc upon the current in the arc and the effect of the atmosphere about the arc on the ductility of the resulting weld. (11c)

Welding Combined with Foundry Practice. W. H. NAMACK & H. M. HOBART. *General Electric Review*, Vol. 33, Dec. 1930, pages 674–676.

Electric welding is employed with much advantage in: (1) ship building construction, (2) steel bridge construction, (3) pipe line construction, (4) construction of various kinds of machinery such as machine tools, electric motors, generators, transformers and switch gear, and (5) construction of pressure vessels. The article purports to call attention to the industrial value of combining the accumulated experience in the foundry and welding arts, and of usefully applying this united experience to the development of the foundry art to a high degree. WHB(11c)

The Welding of Copper. *Industrial Chemist*, Vol. 6, May 1930, page 198.

A satisfactory method for welding copper has been developed which differs slightly in technique from that used on ferrous materials, and employs a copper alloy filler rod and an appropriate flux. It is necessary to use a special copper which is not attacked by the gases of the acetylene flame. The special materials are supplied by Imperial Chemical Industries Ltd., who have developed the process. MPB(11c)

Fusion Welding of Aluminum. *American Machinist*, Vol. 72, June 5, 1930, page 927.

Very brief, condensed summary of part of the present knowledge of fluxes, rods and methods of procedure in fusion welding of aluminum. RHP(11c)

Extracts Report on Strength of Welded Joints in Tubular Members for Aircraft. H. L. WHITTEMORE & W. C. BRUEGGEMAN (U. S. Bureau of Standards). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 107–132. 21 references.

Report No. 348 of the National Advisory Committee for Aeronautics. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 914. LFM(11c)

Electrically Welded Cranes and Their Official Certification. (Elektrisch geschweisste Krahne und ihre behördliche Genehmigung.) E. ROSENBERG. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 20, 1930, pages 1345–1348.

Paper read at the Convention in Vienna of the Verein deutscher Ingenieure. Eight electrically welded bridge cranes and 2 rotating cranes are described and illustrated by many photographs which have been built by several Austrian builders. Ha(11c)

Metallic Electrodes for Cast-Iron Arc Welding. SHUN-ICHI SATOH (Mitsubishi Research Lab.). *American Institute Mining & Metallurgical Engineers, Transactions Iron & Steel Division* (1929) pages 144–165.

Includes discussion. Gray or white iron can be deposited by using an electrode consisting of wrought iron coated with a mixture of SiC and graphite. The coating should preferably consist of SiC and C with 1% barium carbonate bound with water glass. Contains 17 references. JLG(11c)

Building Up Battered Ends of Rails. W. H. KIRKBRIDE (Southern Pacific Co.). *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 69–77.

Either the oxyacetylene method or the electric arc method can be used for welding rail ends. Difficulties encountered by oxyacetylene process are eliminated by electric arc method. The rail and joint bars are not heated and welders do not need such elaborate training. Welding is done with high C welding rods which deposits material with C content similar to that of original rail. Oxyacetylene process is still used by Southern Pacific Company but only for scattered jobs. Inspections have shown that battered joint properly welded by electric arc process, using 0.90–1.10 C coated welding rods, do not batter as rapidly as original rail, due to the higher C contents of the rod. LFM(11c)

Job Shop Welding. H. L. FETTER (Rochester Welding Works). *Journal American Welding Society*, Vol. 9, June 1930, pages 59–61.

Outlines various fields in which welding has been found useful. In up-to-date welding shops it is possible to weld successfully alloy steels, stainless steels, acid-resisting iron, aluminum, monel metal, stellite and copper and bronze mixtures of every nature. LFM(11c)

Fusion Welding of Aluminum. *American Machinist*, Vol. 72, May 29, 1930, page 885.

Gives diagrams of the various types of flames of both oxy-acetylene and oxy-hydrogen. Briefly discusses the use of the torch and gives tables to aid the beginner in selecting the proper size of tip. Oxy-hydrogen when it will supply sufficient heat will produce a cleaner weld. The Oxy-acetylene will give higher temperatures and is, therefore, more widely useful. RHP(11c)

Methods of Testing Welds. GEORGE B. MOYNAHAN. *Metals & Alloys*. Vol. 1, July 1930, pages 607–612; *Metallurgist*, Sept. 1930, pages 143–144.

Detailed description of methods of preparing specimens and technique of (1) tensile tests for strength, (2) bend tests for strength, (3) pressure test for soundness, (4) hydrostatic pressure test, (5) pressure qualification test, (6) inspection tests of etched specimens, (7) reheating tests, bend test for ductility and (8) special tests. More thorough testing of welding is recommended. ESC+VVK(11c)

Resistance Welding of Steel Joists. FRANK BURTON. *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 78–87.

For resistance welding there should be available from 200–300 kilowatts of current for each inch² of surface to be welded, and the pressure should be between 8,000 and 10,000 lbs./in.² of weld. Time may be varied between $^1/_5$ and $1^1/_2$ seconds. Just before current is applied pieces to be welded are forced together at pressure of 2000 lbs./in.² which is quickly raised to 8000–10,000 lbs./in.² after current is applied. Result is perfect fusion of metal at junction which is free from slag or oxide. Plain butt weld is ideal resistance weld. Strength of such welds in tension is 93 or more percent of strength of the original bar. Gives results of tests made upon various types of welded steel joists. In making resistance welds, a slight coating of rust or other foreign matter appears to be essential to the process as it causes localizing of heat at the point of contact. Good welds can be made with steel containing 0.05–0.06% S. Recent tests indicate that sound and reliable butt welds may be made in steels up to 0.65% C. Mn content of 0.40–0.60 is satisfactory for steel of C content 0.15–0.25%. In low C steel, the weld metal is fine grained sorbite. In steel of higher C content, a small amount of poorly developed troostite is found explaining the greater hardness of the weld metal over the original stock. LFM(11c)

The Influence of Current Conditions in Electric Arc-Welding of Soft Steel. (Einfluss der Schweissstrombedingungen bei der elektrischen Lichtbogenschweissung von weichem Flussstahl.) Experiments on Melting Conditions, Tensile Strength Tests, Testing of Welding Defects with X-Rays. N. LEFRING. *Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, Verein deutscher Ingenieure*, No. 332 (1930) 53 pages, 67 references.

Next to the skill of the welder and the character of the materials, that is, the kind of electrode and the metal of the product, the most important factor for the quality of the joint by electric arc-welding is the proper adaptation of current conditions, intensity and kind of current and for direct current also the current direction. The present investigation was primarily directed toward determining the relation between current conditions and fusing process in welding steel, and further in ascertaining in which way the quality of the weld is influenced by current conditions. From numerous tests with alternating current and direct current with either polarity of the electrode it could be stated that the fusing capacity of the electric arc does not change materially with the voltage of the arc, that is, length of the arc, but depends mainly on the current intensity. A fusing number K could be derived in g./amp./min. which was for alternating current 0.177, for direct current with minus electrode 0.161. with plus electrode 0.227. From these values, a basis could be found for the calculation of time required for welding. The quality of the welded seams was tested by determining tensile strength, impact strength, and X-ray pictures were taken from different angles; all these tests are reproduced in numerous tables, diagrams and photographs. A reference to literature on the same subject (mostly German) concludes the exhaustive treatise. Ha(11c)

Electric Welding. JAMES CALDWELL. *Electrician*, Vol. 104, Feb. 21, 1930, page 229.

A brief review pointing out the superiority to riveting, the large saving in cost, and the application to shipbuilding. Discussion brought out the need of a reliable field test for a welded joint. WHB(11c)

Talks on Silver Solders

Chapter I. Characteristics.

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WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

A Study of the So-Called "Overreduced" Condition in Molten Steel. J. V. McCrae, R. L. Dowdell & Louis Jordan. *Bureau of Standards Journal of Research*, Vol. 5, Nov. 1930, pages 1123–1149.

A study was made of 4 heats of acid electric steel for castings in which 2 heats were in the so-called "overreduced" state while the others were in the normal condition as made according to general practice. The 2 types were investigated as regards temperature of the molten metal, structure, and physical and chemical properties. The lower fluidity or "runability" of the overreduced (overdeoxidized) steel manifests itself in a short "filming-over time" with the melters' spoon test. This is apparently caused by the rapid formation of silica, which rises from the steel because of the addition of excess metallic silicon to an oxidized steel. This phenomenon may also be the cause of incorrect judgment of its temperature, since its emissivity is higher than that of a clean liquid steel surface. (12a)

Manufacture of Duplex Steel. *Iron & Coal Trades Review*, Vol. 120, June 6, 1930, pages 913–914.

From the article entitled: "Practice in Making Duplex Steel" by J. E. Carlin, published in *Iron Age*, Mar. 27, 1930, pages 925–927. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. RHP(12a)

Fundamental and Applied Research on the Physical Chemistry of Steel Making. C. H. Herty, Jr. *Metals & Alloys*, Vol. 1, Dec. 1930, pages 883–889; *United States Bureau of Mines, Report of Investigations* 3054, Dec. 1930, 12 pages.

A brief résumé of investigations carried out by a staff of 14 to 23 men per year at the Pittsburgh Experiment Station of the United States Bureau of Mines in coöperation with the Carnegie Institute of Technology and the Metallurgical Advisory Board. AHE+ESC(12a)

Basic Open-Hearth Yields. C. D. King (U. S. Steel Corp.). *American Institute of Mining & Metallurgical Engineers, Transactions, Iron and Steel Division* (1929) pages 197–232.

Includes discussion. Gives methods for calculating open-hearth yields, and discusses losses. JLG(12a)

Open-Hearth Operation from the Chemical Viewpoint. C. H. Herty, Jr. (U. S. Bureau of Mines). *American Institute of Mining & Metallurgical Engineers, Transactions, Iron and Steel Division* (1929) pages 260–283.

An analysis of the open-hearth process. Includes consideration of the charge, the refining process, deoxidation, reactions in the ladle and solidification of the ingots. Contains 6 references. JLG(12a)

Making of Alloy Electric Steels in a High Frequency Furnace. (Preparation des aciers speciaux au four electrique a haute frequence.) A. Lacroix. *Journal du Four Electrique*, Vol. 39, July 1930, pages 246–247.

The results of a year's experience with a 100 kw. high frequency Ajax-Northrup furnace. Current consumption ranged from 580 kwh./ton of high speed steel to 825 kwh. for dead soft steels. Crucibles stood about 30 melts. The greatest trouble was the upkeep of condensers. JDG(12a)

World's Development of Electric Steel Making. (Le developpement mondial d'electrosiderurgie.) R. Savin. *Journal du Four Electrique*, Vol. 39, July 1930, page 246.

Brief review of development of electric steel making in world. JDG(12a)

Aluminum and Magnesium as Deoxidizers. Edmund Thews. *Metal Industry* (London), Vol. 36, May 23, 1930, pages 547–548.

Chief advantages of Al as a deoxidizing agent are its affinity for O, measured by its heat of combustion generated by its action with O, is greater than any other except Mg, and its quantitative deoxidizing capacity measured by the O taken up by a standard unit. Its disadvantages are that at heat of melting process Al_2O_3 does not rise to the surface immediately, as in case of Mg and Si, and that it has affinity for Pb. Mg is being used as deoxidizer in melting Cu and Ni alloys since Mg is highly inflammable at ordinary temperatures of brass melting, Mg-Cu alloys are used for deoxidizing purposes. Other alloys used are Mg-Zn with 50% Mg, Mg-Sn with 50% Mg and Mg-Ni with 50% Mg. VSP(12a)

New Deoxidation Process for Red Brass. W. Reitmeister. *Metal Industry* (London), Vol. 36, May 2, 1930, page 479.

Abstract translation from *Giesserei*, 1929. Raw material is examined as to whether it is over-carburized or oxidized by adding coal dust to molten metal. If properties of metal are deteriorated, the metal is over carburized. A slag containing CuO or ZnO is added to reduce C and to oxidize metal. Then deoxidation with coal dust is carried out. VSP(12a)

The Musso Steel Process. C. E. Parsons. *Canadian Mining Journal*, Vol. 51, Mar. 14, 1930, pages 242–245.

The Musso process provides for the manufacture of steel ingots by the production of sponge iron with melting in suitable furnaces for the purification of the sponge iron and its conversion to steel. Coal is used as fuel and the gas from it and the carbon monoxide produced in the furnace provide the heat for the reduction retort, the operation of the auxiliary apparatus and the melting and steel-making furnaces. A substantial amount of gas of high-heat value is available for outside use. The capital investment is less than 1/2 that of existing plants for making steel ingots. The manufacture of ingot steel by the Musso process costs 20% less than by the open-hearth process and the steel is equal to high-grade electric steel costing twice as much. The process is described, construction features noted and chemical reactions and concentrating and melting of iron outlined. WHB(12a)

The Effect of Melting Conditions on the Graphite Size and Microstructure of Gray Cast Iron. A. L. Norbury & E. Morgan (British Cast Iron Research Association.) *Foundry Trade Journal*, Vol. 42, May 15, 1930, pages 357–359; *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1083–1084.

Part of a paper read before the spring meeting of the Iron and Steel Institute. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 736. MS+VSP(12a)

Physical Chemistry of Steelmaking. *American Institute Mining & Metallurgical Engineers, Transactions, Iron and Steel Division* (1929) pages 233–259.

"Round table" discussion of the physics and chemistry of steel making processes with particular reference to the open-hearth process. At New York, Feb. 1929. JLG(12a)

Electrical Melting Improves Quality and Cuts Cost. *Electrical World*, Vol. 95, May 10, 1930, pages 948–949.

The first vertical-ring induction furnace for melting nickel-silver in Naugatuck Valley went into service last year. Results show an improved quality of alloy and lower melting costs. The life of the lining has increased from 400 heats to more than 800 heats, or 500,000 lbs. per lining. WHB(12a)

Clean Steel. H. W. Gillett. *Metals & Alloys*, Vol. 1, Dec., 1930, page 866.

An editorial commendation of the investigation by C. H. Herty on the physical chemistry of steel making. ESC(12a)

Melting of Steel in a Brackelsberg Furnace with Acid Lining. (Das Schmelzen von Stahl auf saurem Futter im Brackelsberg-Ofen.) P. Bardenheuer. *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1328–1330.

Report of the Kaiser Wilhelm Institut für Eisenforschung. Temperatures up to 1800° C. can be obtained in the Brackelsberg furnace by using a simple checker, which preheats the combustion air from 200° to 300° C. by utilizing the waste gases. In this way steel can be melted in a furnace with acid lining. The advantages of the Brackelsberg furnace, as originally found in melting cast iron, apply also for melting steel. The steel of the Brackelsberg furnace is distinguished by excellent mechanical properties, as well as good casting properties. The fuel consumption for melts of about a ton of steel is not higher than that for large open-hearth furnaces. Therefore, the Brackelsberg furnace is superior to any other steel melting furnace of the same capacity. GN(12a)

Acid Open Hearth or Basic? K. R. Binks. *Iron & Steel Industry & British Foundryman*, Vol. 4, Nov. 1930, pages 53–54.

The same physical properties can be attained by both types of steel if precautions in manufacture are taken since material in both types of open-hearth furnaces is exposed to similar influences during melt down. CHL(12a)

Duplex Practice. J. E. Carlin (Union Drawn Steel Co.). *Transactions American Society for Steel Treating*, Vol. 17, May 1930, pages 631–637.

The paper discusses slag metal reactions, pig iron addition for deoxidation, tapping, and ladle technique in the basic open hearth using acid Bessemer hot metal. The removal of the oxidizing slag and preparation of a neutral or reducing slag as in the electric furnace process is suggested for finishing such steel. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. WLC(12a)

Operation of an Open-hearth Furnace. Part I. Construction and Equipment. Part II. The First Charge. Part III. Fuels. M. J. Conway. *Iron & Steel Engineer*, Vol. 7, March 1930, pages 135–141; May 1930, pages 230–234; July 1930, pages 368–371.

The first of this series of lectures delivered for the benefit of the employees of the Open Hearth Department of the Lukens Steel Company covers the construction of the open-hearth furnace, the arrangement and uses of the various accessory equipment. The second covers a discussion of the preparation of the furnace for its first charge, the materials of the charge and their order of addition, the duties of the attendants, the working period and repair materials. The third discusses the fuel problem particularly as to the use of fuel oil. WLC (12a)

The Preparation of the Metal for Steel Castings in the Converter. J. Leonard. *Foundry Trade Journal*, Vol. 42, June 19, 1930, pages 458–459.

Paper read before annual convention of Institute of British Foundrymen. Operation in converter is to produce liquid steel from liquid pig Fe, air is brought in contact with liquid metal whereby they are oxidized as follows:

$$C + O_2 = CO_2 + 8100 \text{ Cal.}$$
$$Si + O_2 = SiO_2 + 6429 \text{ Cal.}$$
$$Mn + O = MnO + 1653 \text{ Cal.}$$

Addition of calories necessary because: (1) Metal remains 15 or 20 min. in converter and loses some of its calories by radiation; (2) Blast is cold and absorbs from the metal bath calories; (3) Melting point of steel is higher than pig Fe. Law of masses and of affinity govern chemical reactions of converter. From observation the following conclusions are evident: (1) Composition of pig Fe is of importance as the elements Si, Mn and C play part of purifiers; (2) Initial temperature of operation should be suitable; (3) In order to prevent excessive solution of FeO, too high temperature should be avoided; and (4) from start to finish combustion must be carefully controlled. VSP(12a)

Phosphorus as a Deoxidizer. Edmund Thews. *Metal Industry* (London), Vol. 36, April 11, 1930, pages 401–402; April 25, 1930, pages 449–450.

Describes particularly phosphor bronze, its preparation, applications and influence of nature and properties of alloys to which it is added. Apart from phosphor Cu, other P alloys are rarely used. Good results are obtained with a process devised by Heyn and Bauer. Technical application of phosphor Cu. P as deoxidizer is superior to other deoxidizing agents in that only small traces of this element are retained by the metals. Disadvantages become evident only if P is added in excess. Increased temperature range of solidification is due to excess use of P. Gives method of adding phosphor Cu to melts. Influence of phosphor content on bronzes. The changes of mechanical properties of bronzes induced by small % of P vary directly with Sn contents of alloys. Tabulates results of tests made on 2 rolled phosphor bronzes containing traces of P. On account of its corrosion resistance phosphor bronze is used for making tanks, vats and machine parts. VSP(12a)

Improvements in the Utilization of Aluminum Scrap in the United States. (Neuerungen bei der Behandlung von Aluminiumschrott in den Vereinigten Staaten.) Robert J. Anderson. *Metallwirtschaft*, Vol. 9, Oct. 17, 1930, pages 863–866.

Contains 2 references. The use of Al scrap in the U. S. has risen to 45,000 tons annually. 50% scrap is often used in making castings. In a plant for reworking scrap Al proper sorting of different alloys is very important and is done very cleverly by experienced operators. In some cases chemical analysis, electrical resistance measurements or hardness tests are also used. After classifying, foreign metals, Fe, brass, etc., are removed and mixtures are made to obtain definite compositions. Filings are pulverized, screened and put through Steinlein separators. The separated oxide is sold for manufacture of chemicals. Turnings are freed from oil and Fe and pressed into briquets weighing 30 to 60 lbs. The charges are melted in reverberatory furnaces of 5 to 25 ton capacity. The heavy scrap is melted first, flux added, then turnings and briquets and the mass stirred. The process is not continuous. Gas, coal or coke is used. Considerable experience and close technical control are essential for success. CEM(12a)

Casting & Solidification (12b)

The Origin of the Casting Structure. G. Tammann. *Metals & Alloys*, Vol. 1, Feb. 1930, pages 392–395.

Translation from *Zeitschrift für Metallkunde*, Sept. 1929, pages 277–282 See abstract in *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. (12b)

Centrifugal Casting and Its Metallurgical Examination. (Schleuderguss und seine metallkundliche Untersuchung.) M. v. Schwarz & A. Vath. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 27, 1930, pages 1369–1370.

Historical remarks on the development and description of recent methods for casting and measuring the occurring centrifugal pressures. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 388. Ha(12b)

Die-Casting Today. Marc Stern (A. C. Sparkplug Co.). *American Machinist*, Vol. 72, June 26, 1930, pages 1029–1031.

Die-castings are produced in various alloys and are designated by the metal which predominates, as tin base, lead base, zinc base, and aluminum base. Other ingredients usually consist of copper, magnesium, antimony and similar alloying elements, for the purpose of increasing tensile strength, hardness, durability, etc. Gives a description of the A C die-casting machine patented by the A C Spark-Plug Company. RHP(12b)

On the Formation of Graphite During the Solidification of Cast Iron. TUTOM KASE. *Kinzoku no Kenkyu*, Vol. 7, Aug. 1930, pages 397–408; *Iron & Coal Trades Review*, Vol. 121, Aug. 15, 1930, page 223.
See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. KT(12b)

Methods for Determining the Volume Changes Undergone by Metals and Alloys During Casting. C. M. SAEGER, JR. & E. J. ASH. *Transactions & Bulletin American Foundrymen's Association*, Vol. 1, June 1930, pages 107–145.
True shrinkage data were not obtained by the sand-cast-core methods. The more accurate experimental method depends on the construction of the specific volume-temperature curve for the metal under consideration. The liquid contraction curve is constructed from data secured by application of the crucible immersion method. The mass of liquid metal at the temperature of filling the crucible at room temperature. The liquid specific volume is, therefore, easily calculated. The solid contraction curve is constructed from data given by observation of the change in length with temperature change of a sand-cast bar of metal. The solidification shrinkage of an alloy is the difference in specific volume at the beginning and end of freezing range. (12b)

Crystallization and Segregation Phenomena in 1.10 Carbon Steel Ingots. (Kristallisations-och Segringfenomen i 1.10 Kolstalsgüt.) AXEL HULTGREN. *Jernkontorets Annaler*, Vol. 114, March 1930, pages 95–158.
Contains 15 references. Paper read before Iron & Steel Institute Sept. 1929. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 388. HCD(12b)

The Heterogeneity of an Ingot Made by the Harmet Process. A. KRIZ. *Engineer*, Vol. 150, Sept. 19, 1930, pages 306–307; *Iron & Coal Trades Review*, Vol. 121, Sept. 19, 1930, pages 399–401.
Abstract of paper read before the Iron and Steel Institute, Sept. 15, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. LFM(12b)

Corner Ghosts in Steel Ingots. SOJI MAITA. *Iron and Coal Trades Review*, Vol. 120, May 2, 1930, pages 716–718.
Abridged from a paper before the Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 737. RHP(12b)

Modern Die-Casting Practice. ERNEST V. PANNELL. *Engineer*, Vol. 150, Aug. 15, 1930, pages 168–169; Aug. 22, 1930, pages 193–194.
Describes various types of die-casting machines giving diagrams illustrating 2 types. For dies it is necessary to have steel capable of resisting effect of molten metal many times per hour at the melting temperature of Sb, Pb, Zn and Al. For first 2 metals, a low-C steel is satisfactory. For Zn a higher C heat treated steel is used but for Al a special alloy steel is necessary. Cr-V, Ni and W-Cr steels have been used. Recently a die steel has been used of 4–8% W and 3% Cr. Shrinkage allowed for on the dies takes into account fact that their working temperature is 350° C. while that of molten Al is 700° C. In case of Zn, die temperature will be about 220° C. and metal 440°. After forging and before cutting, die-blanks are normalized and annealed. W-Cr steel is heated to 1010° C., air-cooled and tempered at 565°C. Practice is being developed of Cr plating the die surfaces which prevents oxidation and gives greater life to the die and a better finish to the final castings. After tempering, Brinell hardness of dies should be 400–440. Discusses development of die-casting metals and alloys giving summary of alloys adopted for test by the American Society for Testing Materials. LFM(12b)

Moulding and Casting. J. ELLIS. *Foundry Trade Journal*, Vol. 42, May 8, 1930, pages 348; May 29, 1930, pages 397–398, 408.
Paper read before the Scottish Junior section of the Institute of British Foundrymen. It is important that facing-sand be mixed and made correctly for each job. Bad strips, scabs, mapping, blow-holes, streaky veins, are all due to badly mixed facing-sand. Best results are obtained when molds are poured with hot metal. Core plates should be placed well below the casting. If plate is too close contraction is impeded and casting cracks. Using block points over chipping strips is advantageous. By using top runners only, there is a danger of crown of mold scabbing by the force of metal dropping. This is avoided by pouring about a ton of metal in at the bottom. Anchoring cores and sealing joints. Other topics discussed are: Condenser molds, pipes without chaplets, pulley and lettering castings, core venting and burning on. VSP(12b)

Rolling (12c)

Rolling Mill Analysis. E. KIEFT (Illinois Steel Co.). *Iron & Steel Engineer*, Vol. 7, June 1930, pages 258–265.
The author gives a mathematical analysis of the reduction of metal in a rolling mill accompanied by diagrams and sample calculations. Discusses the relations of size of work to size and weight of the rolls. WLC(12c)

Practical Suggestions for Rolling Shapes. (Praktische Ratschläge für das Walzen von Formeisen.) H. RUPPE. *Stahl und Eisen*, Vol. 50, Oct. 9, 1930, pages 1430–1431.
The article gives a general discussion on the best type of mill for special shapes, describes a special device to avoid warping of shape due to the difference of the working diameters of the rolls and points out the usefulness of alloy steel rolls. GN(12c)

Equipment for Measuring Rolling Pressure. (Vorrichtung zur Druckmessung an Walzwerken.) E. VOIGT & W. LUEG. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, Report 154 (1930) pages 161–164; *Stahl und Eisen*, Vol. 50, Oct. 9, 1930, pages 1442–1443.
The authors designed a simple instrument to measure the rolling pressure in rolling mills. An elastic measuring box, filled with mercury is deformed by the rolling pressure, thus displacing the mercury into an attached tube of small cross-section. This tube is provided with contact points which are connected with electric bulbs. The course of the rolling pressure can also be registered. Rolling pressure curves were taken in cold rolling soft steel. The instrument is suitable for supervising the rolling process. GN(12c)

Rolling an Ingot into a Billet in 19 Carefully Planned Passes. F. G. GASCHE (Bethlehem Steel Co.). *Iron Age*, Vol. 126, August 7, 1930, pages 351–352.
From a paper read before the Association of Iron and Steel Electrical Engineers at Buffalo, June 17, 1930. Gives diagrams showing surface contour of rolls and end view of tapered ingot. It was estimated that work required to produce the billets was 24 kwh. a ton. VSP(12c)

The Theory of Rolling Plastic Materials. F. G. GASCHE (Bethlehem Steel Corp.). *Iron & Steel Engineer*, Vol. 7, June 1930, pages 325–339.
The author gives a mathematical study of rolling mill practice including discussion of cluster mills for sheet and plate. Stresses in the material being rolled and in the rolls are analysed. Energy requirements are calculated. The theory is applied to the calculations for a 34 in. reversing blooming mill. WLC(12c)

Forging (12d)

Economy in the Forge Shop. (Betriebswirtschaft in Schmiedebetrieben.) H. KLINAR. *Stahl und Eisen*, Vol. 50, Oct. 9, 1930, pages 1425–1430.
Report No. 77 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Investigations on the fuel consumption of forge furnaces show that the fuel loss is generally very high due to the varying size of the heated pieces. This condition could be improved by the use of movable furnaces or furnaces provided with a partition wall. Good heat insulation, regular charging and uniform heating times are of importance as well as a suitable distribution of the men in charge of the forge hammers. The steam consumption of the hammers, used directly for forging cannot yet be measured, but is approximately calculated from the number of blows. GN(12d)

Extruding (12f)

Continental Practice in Non-Ferrous Metals Extrusion. *Metal Industry* (London), Vol. 36, June 20, 1930, pages 645–646.
Discusses progress made in Sweden, Norway, Italy and Germany. Greatest progress has been made in Sweden. British machinery methods are preferred. Metals used include 70:30 and 60:40 cupro nickel, aluminum, etc. (To be continued.) VSP(12f)

Machining (12g)

The Future of Tungsten Carbide as a Cutting Tool. WILLIAM H. MCCOY. *S.A.E. Journal*, Vol. 27, Nov. 1930, pages 557–559.
The savings realized on a number of other jobs are tabulated. Some classes of work are enumerated in which failures have been encountered, and some causes of these failures, and remedies for them are said to be found in large tips and annealed shanks. As no one type of tool steel has been found suitable for all jobs, the author predicts that a number of varieties of tungsten carbide will be developed, differentiated by modifications in the binder and graduations in the grain sizes of the tungsten-carbide particles. This will make it possible to select a tool material suitable for the job, instead of picking out jobs that can be done by the material. 9 references. (12g)

Tungsten Carbide Tools. ROGER D. PROSSER. *Transactions American Society for Steel Treating*, Vol. 17, June 1930, pages 749–764.
Paper presented before the Boston Chapter of the Society, June 1929. Discusses results obtained in actual production work with tungsten carbide tools. Practical recommendations as to use, brazing and grinding of such tools are given. The author warns against their indiscriminate use without regard for the conditions to be met in the service. WLC(12g)

Finest-Machining of Metal Pieces. (Feinstbearbeitung von metallischen Werkstücken). O. SCHLIPPE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Sept. 20, 1930, pages 1329–1339.
The importance of the quality of the surface of machine parts sliding upon one another is emphasized; the methods are described to measure the depth of traces on the surfaces remaining from the machining processes. Various methods are described for the finest finishing processes, as grinding, boring, lapping, polishing (manually and automatically) of cylindrical and flat parts and of cranks, gears, etc., of "honing" for polishing crank-shafts, the draw-grinding of cylinder bores, cold-rolling of bearing supports of shafts and the press-finish of holes. The paper is profusely illustrated and has 12 references. It is, however, pointed out that these delicate methods should be applied only if absolutely necessary; a curve shows the costs of a piece as function of the required tolerances, and economy has to decide up to which degree of accuracy one can go. Ha(12g)

Sawing Armor Plate with a Carboloy Saw. *Machinery*, Vol. 36, May 1930, pages 721–722.
Taken from the April number of *Carboloy*. In a test for the Navy Department a saw equipped with carboloy tooth points was used for cutting a strip of treated armor plate 16 inches thick, 9 feet across, and 17 feet long. Describes saw construction. The saw was run 12 hours without resharpening and without a coolant. Later experiments proved it better to use a lubricant. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 737. RHP(12g)

Machines for Tungsten-Carbide Tools. *Machinery*, Vol. 37, Sept. 1930, page 48.
Summarizes the suggestions made regarding the construction of machines to be used with tungsten-carbide tools. RHP(12g)

New Applications of Tungsten-Carbide Tools. *Machinery*, Vol. 36, July 1930, pages 892–894.
The Machine Shop Practice Division of the American Society of Mechanical Engineers at the semi-annual meeting at Detroit, June 9–12 devoted an entire session to papers and reports on Tungsten-Carbide tools. This is a brief review of that session. Discusses the use of tungsten-carbide; in lathe tools, for saws, for heavy machine tools. Present applications, materials for which it may be used, machine equipment, tool sizes, grinding of tungsten-carbide tools, cutting speeds, results and failures of tools. RGP(12g)

Machinability and Tensile Properties of Steel and Cast Steel. (Zerspanbarkeit und Festigkeitseigenschaften von Stahl und Stahlguss.) A. WALLICHS & H. DABRINGHAUS. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Aug. 30, 1930, page 1220–1221.
As characteristic of the machinability is designated the cutting velocity per hour V_{60} which requires a change of cutting tool after 1 hour. These values are plotted as function of the feed of the tool, and from the curves it can be deduced that doubling of the feed causes doubling the reduction in cutting velocity as is caused by doubling the depth of the chip. Further, the tests showed that the machinability of usual materials of the same kind and same strength is the same and hardly changed by normal alloying elements nor by changing of structure by heat-treatment. Ha(12g)

New Developments in Machining Aluminum and Its Alloys. R. L. TEMPLIN. *S.A.E. Journal*, Nov. 1930, pages 548–552.
Comparatively large rake and clearance angles required for best results leave a relatively thin cutting-edge on a cutting tool for aluminum. One difficulty encountered is that tools of such form are not always available or suitable, for various reasons; for instance, small tools of various types are available only with cutting edges suitable for steel and bronze, and the desirable amount of top rake cannot well be provided on circular form-tools. Tool bits of various sorts can be reground to the desired angle. A simple round form of tip that is shown can be utilized in tools for various purposes, including use as inserted teeth in a face-milling cutter. High-speed-steel tools are suitable for most aluminum alloys, but alloys containing a high percentage of silicon can be machined to advantage only be using cemented tungsten-carbide. Machine tools should be suitable for high speed. Rigidity is required and lost motion must be prevented to guard against a tendency of the thin points of the tools to dig into the work. 16 references. (12g)

Haynes Stellite Cutting Tools. W. A. BECKER, E. E. GORDON & W. A. WISSLER (Haynes Stellite Co.). *Preprint* No. 7, Dec. 1930 Meeting, *American Society of Mechanical Engineers*, 6 pages.
The red-hardness of the Co-Cr-W alloy, Stellite No. 3, for machine tools (composition not stated) is compared with that of high speed steel. From about 400° C. up, Stellite is the harder. At 800° C. Stellite shows about 50 Rockwell C, while high speed shows about 12. The Monotron hardness tester is preferred for determination of high temperature hardness. Stellite has been successful on machining cast, high-test and malleable irons; mild steel, if the tool and the work have sufficient rigidity; and some miscellaneous materials, but is not successful on alloy steels, or in automatic or semi-automatic machines for cutting steel. Comparisons are made with high speed steel for milling, boring and turning cast iron and mild steel, and for turning bronze, to show increased production per unit time and per grind, through the use of Stellite tools. "Their successful operation depends on the proper ratio of speeds, feeds and methods of application. In milling, hardness of material machines, kinds of fixtures used, condition and strength of machine, nature of castings, proper selection of cutters and proper cutting and clearance angles have an important bearing on final results." (12g)

Machining Properties of Some Cold-Drawn Steels. O. W. Boston (University of Michigan). *Preprint* No. 9, Dec. 1930 Meeting, *American Society of Mechanical Engineers*, 12 pages.

Fifteen cold-drawn steels, including S.A.E. Nos. 1112, 1120, 1230, 1315, 2320 and 6141, "super-free-cutting" screw stock with 0.20% S and a 0.35% C, 1.70% Mn with low sulphur and a higher carbon type of S.A.E. 1320, as well as an 0.06% C, 13.4% Cr low sulphur stainless, and a free-machining 0.09% C, 15.2% Cr, 0.46% S, 0.25% Mo composition, were studied by observing the forces required in planing, in drilling, and in a milling, the last being observed by use of the Oxford pendulum tester, which cuts a chip with a single tooth, the energy being read in a manner similar to impact testing. Drill penetration was also observed. The low-sulphur stainless was about twice as difficult to machine, by all the tests, as the usual cold-drawn stock. The presence of the S and Mo in the free-cutting type, brought the machinability close to that of usual stock. The 2320, 6140 and low-S, high-Mn alloy steels in most of the tests were appreciably more difficult to machine than the usual stock. In all the other plain carbon and high-Mn, high-S stocks, the general trend was for better machinability the higher the Brinell in the range covered, 156 to 207. The finish left on the different steels by a shaper tool was studied to some extent. Tool life was not studied. While general trends were consistent on the whole, there were many variations, and the relative machinability of 2 steels depends on what type of machining is in question, on the nature and form of the cutting tools, on size of tool, depth of cut and feed, on the lubrication, on the composition, structure and degree of cold working. In the operation of milling, cutting with or against the feed may show as much variation in energy required as do steels of quite different compositions and structures milled in the same direction. Tools of different composition vary in the results obtained on the same steel when milling with and against the feed. The size of the bar, i. e., the degree of cold working, did not appear to be a major variable, the results for different sized bars of the same material generally showing good agreement. In the drill penetration tests, the whole series of steels was tested with one drill, not re-sharpened. The slight dulling of the drill was found to be less of a variable than the difference in the action of the same drill after re-grinding, even on a machine. The data are given in tables and curves, too extensive for reproduction. Micrographs are shown of all steels studied. HWG(12g)

Cemented Tungsten Carbide as Applied to Cutting Tools. L. J. St. Clair (Carboloy Co.). *Preprint* No. 50, Dec. 1930 Meeting, *American Society of Mechanical Engineers*, 5 pages.

Cemented tungsten carbide, beside extreme hardness, has the highest compressive strength and highest modulus of elasticity of any known material, low electrical conductivity, and a thermal coefficient of expansion only $^1/_2$ that of Invar. In the use of cemented tungsten carbide machine tools, the proper clearance angle is very important, and the machine and tool set-up must be rigid. The material is only about $^1/_2$ as strong in transverse rupture test. This fact, plus its high modulus, makes the material refuse to bend without breaking. Failure to comply with the need for rigidity is one of the chief causes for tool failure. Rigidity in the set-up of the grinding machine used for dressing the tools is also important. Light pressure and slow feed with wheel surface speed at about 5000 ft./min. are preferable for grinding. HWG(12g)

The Problem of Machinability Measurements. E. S. Herbert. *Metallurgia*, Vol. 2, Sept. 1930, pages 169–171; Oct. 1930, pages 206–208; Vol. 3, Nov. 1930, pages 13-15.

After reviewing many possible ways of measuring machinability, the author explains Taylor's formula $V\ T^n = C$, in which V is the cutting speed in ft./min., T is the tool life in min., and C is a constant depending on the cutting conditions other than speed. French and Digges adopted this method and took the value of $^1/_7$ for n, but no qualitative relationship could be found between the "Taylor Cutting Speed" and the hardness, tensile and other physical characteristics of the steels. The problem of machinability has been attacked by several investigators working on the assumption that the machinability of a metal can be measured by the force or forces on the tool used to cut it. Thus the forces on a planer tool have been measured by O. W. Boston (University of Michigan); the forces on a lathe tool by Dempster Smith (Manchester) and by Boston, Wallichs, and Schlessinger; while the torque exerted by a twist-drill when drilling holes in metals has been measured by these investigators, and by Patkay (Charlottenburg), and by Benedict and Hershey (University of Illinois). A form of permissive feed test for machinability introduced by the author has the merit of not involving the use of any but standard workshop equipment, while the test can be made by any mechanic. This test consists in making a cut with a gravity fed hack saw through a bar of standard diameter, 2 in., and counting the number of strokes in cutting through the bar. In making the test it is advisable to use a saw blade sharpened to a standard shape of tooth on an automatic saw-grinder, and to use a newly sharpened blade for each test. "Machinability" cannot be determined by any simple test. A study of chip formation and chip hardness shows that in some cutting a keen and efficient cutting edge of the metal cut is formed on the tool. Due to this edge blunt tools are frequently more efficient than sharp tools. Hardness measurements of the chips with the pendulum tester show that many anomalies can be explained by variations in work hardening capacity. JLG+GTM(12g)

Tool-Steel Tools. A. H. d'Arcambal (Pratt & Whitney Co.) *Preprint* No. 16, Dec. 1930 Meeting, *American Society of Mechanical Engineers*, 8 pages.

Some general principles in the design of cutting tools of high-speed steel are discussed. Sketches show clearances of a few lathe tools, and reamers, taps, dies, milling cutters, slitting saws and form cutters briefly discussed from the point of view of design of the tool. In reaming and tapping, the same size tools will produce holes and threads of different dimensions depending on the material cut and the lubricant used. The usual compositions of plain carbon tool steel, and of vanadium or chromium alloy tool steel, and of three oil-hardening, non-deforming tool steels are given. The water-hardening tool steels give better results in service than the non-deforming steels. The usual precautions for heat treatment of regular high speed steel, are given and the advantages and disadvantages of cobalt additions are pointed out. Since large bar stock cannot be made at present without harmful segregations, forgings should be used for large tools. Microstructures and fractures are illustrated to show the superiority of forgings. Microscopic inspection of all incoming shipments of tool steel is necessary if the tool manufacturer is to control his product properly. In d'Arcambal's opinion, electric furnace alloy and high speed steels are superior to those made in crucibles. Emphasis is put on the necessity for care in grinding tools so as to prevent formation of grinding cracks. HWG(12g)

The Present Status of Cemented Tungsten Carbide Tools and Dies. Zay Jeffries. *Transactions American Society Mechanical Engineers, Machine Shop Practice*, Vol. 52, Jan.-Apr. 1930, pages 29–37.

After discussing the origin, production and properties of cemented tungsten carbide, the author takes up the matter of utilizing the material in cutting tools. Its adaptability for wire-drawing and blanking dies is brought out, as well as its ability to cut hitherto unmachinable materials such as glass, porcelain, asbestos products, etc. Data are given on the life of cemented tungsten carbide tools as compared with older types of tools on a varied assortment of machining jobs, following which the author concludes with a brief consideration of the commercial situation and the future possibilities of the material. See *Metals & Alloys*, Nov. 1929, pages 222–225. (12g)

Drawing & Stamping (12h)

The Drawing of Monel Metal Tubes. Edward S. Richards. *Metal Industry* (London), Vol. 36, May 23, 1930, page 552.

Monel metal has a composition of 67% Ni, 28% Cu and the remaining 5% made up of Fe, Mn, Si, etc. It must be annealed in closed furnace pot. Passes should be lighter than those given to brass owing to hardness of the metal. Tallow is used as lubricant; in finishing passes rape oil and tallow mixed. After tube becomes hard it is annealed at 800° C. and cooled. It is pickled in dilute vitriol, with HNO_3. Steel used for dies must be hard and close grained to withstand wear. Gives typical examples. VSP(12h)

The Manufacture of Thin-Wall Tubing. William S. Lyhne (Fulton Sylphon Co.), *Machinery*, Vol. 36, July 1930, pages 860-864.

A machine designed by Fulton and Giesler of the Fulton Sylphon Co., Knoxville, Tenn. is being used successfully for drawing tubing with a wall thickness of 0.004" and a diameter from 1" to 9". Loss from scrap due to parting or breaking of tubes is less than 1%. The former draw-bench method brought losses as high as 35%. The tube as it passes through this machine is subjected to both a pulling and pushing action. Instead of continuous motion the tube is given a series of intermittent movements each equal to 8". Gives detailed description and illustration of the construction and working of the machine. This process has been commercially applied to zinc, brass, aluminum and copper. Zinc which usually is difficult to draw can be drawn to the same length and wall thickness as other metals with this machine. RHP(12h)

On Surface Stretching, Formation of Folds and Prevention of Folds during the Drawing of Hollow Bodies. (Ueber Oberflächendehnung, Faltenbildung und -verhinderung beim Hohlgefässziehen.) F. Fischer. *Dissertation, Technische Hochschule Stuttgart* (1927) 64 pages.

This thesis for a doctor's degree is intended to throw light upon the relationship between stretching, formation of folds, dimensions of the material to be shaped, thickness of sheets and the lubricant. Emphasis is placed on the selection of a proper lubrication medium and the superiority of Muzin was established. The diagram of drawing radii of Kaczmarek proved to be a valuable aid in the shaping process. The formation of folds is principally caused by the application of incorrect drawing edge radii, by the application of an unsuitable lubricant and too large a pressure of the sheet holder. The superiority of the pneumatic sheet holder was proven and new conversion tables valuable in the drawing process are established. EF(12h)

Cold Working (12j)

Cold Work and the Physical Properties of Metals. *Metallurgist*, June 1930, pages 85–86.

A very complete abstract of the paper of R. L. Templin at the Cleveland meeting of the American Institute of Mining and Metallurgical Engineers which is also abstracted in *Heat Treating & Forging*, Vol. 16, March, 1930. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. VVK(12j)

The Cold Rolling of Strip Steel. S. Badlam. *Advance Copy, American Iron & Steel Institute*, Oct. 1930, 80 pages.

Extended description of the process, with special reference to its development from the historical point of view. The history of backed-up rolls in cluster mills and of exerting tension on the strip simultaneously with rolling is especially dealt with. HWG(12j)

The Strain Hardening of Some Materials during Cold Rolling. (Die Verfestigung einiger Werkstoffe beim Kaltwalzen.) E. Greulich. *Stahl und Eisen*, Vol. 50, Oct. 2, 1930, pages 1397–1401; *Iron Age*, Vol. 126, Dec. 18, 1930, page 1832.

The decrease of the physical properties of the following materials was studied during cold rolling: 5 carbon steels with 0.12–0.61 carbon, a 5% nickel steel, 3 chromium steels (12.56–15.36% Cr), a chromium-nickel steel (35.20% chromium, 10.50% nickel) and monel metal. The reduction of area amounted up to 50%. The results are: hardness, yield point and elongation are heavily influenced at reductions of 1%. The tensile strength and reduction of area do not increase unless a reduction of 6% is obtained. The largest amount of the changes of the physical properties takes place for deformations up to 10%; still larger deformations do not bring about an essential change. Hardness, yield point and tensile strength follow an exponential law for deformations up to 30%. By means of this law it could be proven, that the strain hardening of the carbon steels is independent of the carbon content. Alloy steels, providing they have a pearlitic structure, do not strain harden more than plain carbon steels. Austenitic chromium-nickel steel and monel metal can be much more strain hardened, which leads to the conclusion that structural and atomic composition have a certain influence on the strain hardening process. VSP+GN(12j)

Cleaning (12k)

Cleaning Metal for Painting. E. Palin Spruance (American Chemical Paint Co.). *S.A.E. Journal*, Vol. 27, Sept. 1930, pages 366–367.

Removal of rust, oil, grease, soldering compounds and paint preparatory to painting of automobile bodies is considered. (12k)

Production Cleaning. Tom L. Wheeler, Jr. (Hobart Mfg. Co.) *Metal Cleaning & Finishing*, Vol. 1, Dec. 1929, pages 651–656, 666.

The factors which govern the selection of proper equipment for cleaning are: the type of foreign matter to be removed, the composition of the metal, the size of the parts, the operations immediately preceding and following cleaning, the maximum temperatures to which the cleaning bath can be heated, and the quantity to be cleaned. Describes various types of cleaning equipment and points out their applications and method of operation. In most designs, the principle utilized is that of the movement of the cleaning solution over the work. This is accomplished by various means, the spray system being preferable. In general, washing machines are of the flat conveyor type or the rotary drum type. Describes also auxiliary equipment, such as driers and rinsing units. MS(12k)

Polishing & Grinding (12l)

Manufactured Abrasives. F. L. Nobes. *Industrial Chemist*, Vol. 6, May 1930, pages 183–184.

A discussion of the history, manufacture, and chemical and physical properties of silicon carbide (carborundum) and fused alumina. MPB(12l)

Finishing Stainless Steel. Jack Pearsall (Hanson-Van Winkle-Munning Co.). *Machinery*, Vol. 36, July 1930, pages 870–872.

Stainless steel cannot be polished by the same operations which are used for cold-rolled carbon steel. For ordinary stainless steel use: 1. Soft face cloth wheel coated with abrasive grain No. 60 to 70, wheel surface speed of 6500 to 7500 ft./min. 2. Soft face cloth wheel, abrasive grain size No. 100 to 120, the cut should cross the previous one, same wheel speed. 3. Same type wheel and speed, abrasive grain size No. 150 to 200. Use a light lubricant and cut across previous cut. 4. Softer wheel than those used before, same speed, No. 200 to 220 abrasive, cut across previous cut. Use plenty of lubricant. 5. Method called "bobbing" is preferable. Mix No. 220 grain abrasive with a heavy machine oil to a heavy consistency, use this with a bullneck, walrus or sheepskin wheel without abrasive coating. 6. Buff with high-count sheeting buffs such as 88/88 or 84/92 at surface speeds of 10,000 ft./min. Care must be used in all operations not to apply too much pressure or to over-heat the work. RHP(12l)

Coloring (12m)

Colored Metals. JULIUS GRANT. *Metal Industry* (London), Vol. 36, April 25, 1930, page 450.
Metals may be colored by plating, either electrolytically or mechanically, by chemical reaction, or by painting or enameling. Future developments will take place along the lines of plating and chemical reaction. By chemical methods there is the greatest scope for ingenuity in production of colors on metals. Very little has been done on the method. Oxide films are best known examples of chemical coating. Other methods of coating are: rolling or welding metal sheets together, zinc coating and spraying. VSP(12m)

Sand Blasting (12n)

Metal Abrasives. A. B. MCDANIEL. *Metals & Alloys*, Vol. 1, July 1930, page 614.
Steel shot and grit are manufactured by a variety of different firms, a list of which is included. Various uses are enumerated. Data on production over the past ten years are included. ESC(12n)

DEFECTS (13)

Intercrystalline Cracking in Steam Boilers Cause of Many Boiler Explosions. *Iron & Coal Trades Review*, Vol. 120, June 20, 1930, page 988.
Abstract of a paper entitled, "Intercrystalline Cracking in Steam Boilers," by F. G. Straub before second World Power Conference at Berlin. RHP(13)

The Heterogeneity of Steel and the Relationship of Macrographic Examination. ROGER POWELL. *Iron & Steel Industry & British Foundryman*, Vol. 3, Sept. 1930, pages 369–371; Vol. 4, Oct. 1930, pages 29–31.
Roughly classified, heterogeneity encountered in steel of miscellaneous sizes and sections are mechanical defects, crystal growth and chemical segregation. Mechanical defects are mainly pipes, roaks and seams. CHL(13)

Some Common Defects in Steel for Gear Manufacture. FRANCIS W. ROWE. *Metallurgia*, Vol. 2, Oct. 1930, pages 198–200.
Gears must be made from exceptionally high quality steel. The hot acid test should be applied to all steels used for gears. Some of the common defects revealed by this test are: residual pipe, "V" segregation, rim segregation and ingot corner weakness. Other frequent defects are slag inclusions and variation in analyses. JLG(13)

Defects in Cast Brass Are Revealed by Deep Etching. W. F. GRAHAM & L. A. MEISSE. *Foundry*, Vol. 58, July 1, 1930, pages 92–93; *Metal Industry*, (N. Y.), Vol. 28, June 1930, page 287; July 1930, pages 331–333.
Abstracted from a paper read before the American Foundrymen's Association in Cleveland, May 12 to 16, 1930. Describes some typical results obtained in deep etching non-ferrous metals and alloys, especially brasses and bronzes. Tests confined chiefly to red brasses, alloys containing Cu, Sn, Pb, and Zn of about 85–5–5–5. Deep etching does not only reveal inclusions and character of metal from an oxidized standpoint, but also porosity, lamination or actual fissures. Contamination of red brass by Fe promotes serious difficulty in machining operation. Porosity in castings can be determined quickly by etching. VSP(13)

Normal and Abnormal Steel. (Normaler und abnormaler Stahl.) E. HOUDREMENT & H. MÜLLER. *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1321–1327, 20 references.
Report 166 of the Material Committee of the Verein deutscher Eisenhüttenleute. The paper gives a summary on the present state of the problem of abnormal steel with special reference to the American investigations. In case-carburizing low carbon steel failures are observed which are due to the appearance of soft spots which did not harden. All abnormal steels harden uniformly by quenching them in brine, so that there are practically no difficulties in hardening abnormal steels. The appearance of soft spots is in relation to a slight change of the critical cooling velocity, which occurs in rimmed or effervescing steels. Killed steel is always normal. All these alloying elements like Mn, Cr, Ni which cause a decrease of the critical cooling velocity eliminate all characteristics of an abnormal steel. Other alloying elements favor abnormality. The terms normal and abnormal should not be used to determine the quality of a steel, and the case-carburizing test is not sufficient to pass on normality or abnormality of a steel. GN(13)

CHEMICAL ANALYSIS (14)

The Determination of Calcium by Ignition of Calcium Oxalate to Carbonate in Air. H. H. WILLARD & A. W. BOLDYREFF. *Journal American Chemical Society*, Vol. 52, May 1930, pages 1888–1892.
Ignition of calcium oxalate was studied at 350, 400, 450, 500, 550 and 600°. Between 450 and 500 the oxalate is quantitatively converted into carbonate in 1–2 hours. This is made the basis of an accurate method for the gravimetric determination of calcium. A simple method is described for adjusting the furnace temperature by utilizing the melting points of silver chloride (455) and lead chloride (501). MEH(14)

The Micro Determination of Halogens and Metals in Organic Compounds. H. H. WILLARD & J. J. THOMPSON. *Journal American Chemical Society*, Vol. 52, May 1930, pages 1893–1897.
The micro method is based upon the oxidation of the sample with fuming sulphuric acid. The halogen is distilled into alkaline arsenite and then precipitated as silver halide. Metals may be determined in the same solution from which the halogen has been removed. The whole process is simpler and more rapid than in the macro method. MEH(14)

The Use of Ortho, Para-Dihydroxy-Azo-Para-Nitrobenzene as a Test for the Magnesium Ion. EDWARD WILLIAM ENGEL. *Journal American Chemical Society*, Vol. 52, May 1930, pages 1812–1814.
A new technique for the use of o,p-dihydroxy-azo-p-nitrobenzene as a test for the magnesium ion is described. It is found that the test is valid in the presence of any one of all of the common cations met with in qualitative analysis and in a great many combinations of these cations. Ni, Co, or both do not confuse the test. Acetates, tartrates and ammonium salts do not interfere but increase the sensitivity of the test. The test can be used most efficiently as a substitute for the classical magnesium ammonium phosphate method. According to the method and technique described, it is claimed that 0.003 mg. of Mg can be detected. MEH(14)

Determination of Iron in Aluminum. G. AGAMENNONE. *Giornale di chimica*, Vol. 12, October 1930, pages 486–487.
To avoid errors due to presence of Ti in the usual methods involving titration of ferrous Fe, titration of ferric Fe is advised. A 5 g. sample is dissolved in 50 cc. H_2O + 75 cc. concentrated HCl, diluted to 250 cc., filtered, and a 100 cc. aliquot taken, to which 5 cc. H_2O_2 is added. After boiling 15 minutes, the Fe is precipitated by sodium bicarbonate, the solution neutralized with HCl, and 3 g. KI added, the flask stoppered, cooled and allowed to stand 25 minutes. The liberated I is then titrated with $n/10$ sodium thiosulphate (1 cc. = 0.002792 g. Fe) and starch indicator. No analyses are given to compare this with other methods. HWG(14)

HISTORICAL & BIOGRAPHICAL (15)

Fifty Years in Iron and Steel Works. W. OGDEN DAYSON. *Proceedings Institution of Mechanical Engineers*, No. 5, 1929, pages 1061–1067.
Abridged from an address before the South Wales Branch, in Swansea, Nov. 13, 1928. Discusses progress of the industry under the heads of: apprenticeship, fitting shops, foundries, other shops, capacity, blast furnaces, hot-blast stoves, blast engines, iron mills and steel. RHP(15)

Ancient Egyptian Implements. *Iron & Coal Trades Review*, Vol. 120, May 30, 1930, page 873.
Brief abstract of a paper entitled: "The Metallography of Some Ancient Egyptian Implements" by Sir H. C. H. Carpenter & Dr. J. M. Robertson. Presented before the Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 739. RHP(15)

Pewter: Its History, Development and Manufacture in the United States. FRANCIS A. WESTBROOK. *Metal Industry* (London), Vol. 36, May 2, 1930, pages 477–479.
Includes a brief historical review. Art of making pewter began in America about the middle of the 17th century and flourished until the middle of the 19th century. Roman pewter averaged about 75% Sn and 25% Pb. Late French and English pewter was a mixture of 100 parts Sn and 5 parts Cu for the better grade, and 100 parts Sn and 15 parts Pb for the poorer grade. Modern No. 1 alloy contains 90.7% Sn, 7.8% Sb and 1.5% Cu and is used for hammered objects with minimum amount of raising. No. 2 alloy has 92% Sn, 5% Sb and 3% Cu. Considers present day manufacture. VSP(15)

The Early Use of the Metals. T. A. RICKARD. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 297–365.
Includes discussion. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 739.(15)

ECONOMIC (16)

The World's Resources of Tungsten. (Världens wolframmalmtillgångar.) HARALD CARLBORG. *Jernkontorets Annaler*, Vol. 114, Sept. 1930, pages 455–490.
Discussion of occurrence, uses, consumption, prices, geographical distribution and statistics. HCD(16)

The Supply of Minerals and Metals. *Iron & Coal Trades Review*, Vol. 120, June 27, 1930, page 1027.
Abstract of the presidential address of James G. Lawn before the Institution of Mining and Metallurgy in London, June 1930. The address was "Periodical Variations in the Price of Minerals and Metals." RHP(16)

The Tungsten Situation and Its Effect upon High-Speed Steel Prices. *Machinery* (London), Vol. 35, Jan. 2, 1930, page 456.
The effect of ferrotungsten ore prices on the tool steel industry is discussed. Consideration is given the reasons for the increase in price and the outlook for the future. The key to the situation seems to lie in China and, when it is known through what channels regular supplies can be obtained from that country, a clearer view of the situation should be possible. (16)

The Malayan Tin Position. B. SOMERSET. *Metal Industry* (London), Vol. 36, April 25, 1930, pages 451–452.
The Federated Malay States is the richest tin bearing country in the world, producing about 1/3 of world's total supply. Practically all known methods of mining are in vogue. The largest output of Sn is still obtained by means of gravel pumping. The highest price ever recorded for tin was $212.00 per pikul in Feb. 1920. A comprehensive plan of research for 1930 announced. Gives production and delivery statistics for a number of years. VSP(16)

French Ironmaster Association. *Iron & Coal Trades Review*, Vol. 120, May 30, 1930, page 874.
Annual report of the Comite des Forges de France for 1929. Comments on the trade symptoms of the last few months. RHP(16)

Conditions in the Continental Iron and Steel Industry. *Iron & Coal Trades Review*, Vol. 120, June 27, 1930, pages 1032–1033; Vol. 121, July 4, 1930, page 10; July 11, 1930, pages 40–41.
Extracts from the report of a delegation on the "Industrial Conditions in the Iron and Steel Industries in France, Belgium, Luxemburg, Germany and Czecho-Slovakia" issued by the Economic Advisory Council. Discusses war, and post-war conditions in the above countries. Deals largely with labor and wage conditions. RHP(16)

Antimony in 1929. PAUL M. TYLER. *Mineral Resources of the United States* (1929) Part 1, *United States Bureau of Mines*, Oct. 22, 1930, pages 45–56.
Domestic consumption of new antimony rose in 1929 almost to the high point of 1926. No shipments of domestic antimony ore were reported, the entire producton of 3052 tons (25,669 tons antimonial lead) being a by-product from lead smelters. Of this, 2311 tons of antimony (17,062 tons antimonial lead) were from domestic ores. The recovery of secondary antimony was 11,131 tons. AHE(16)

Economic Relations of Silver to Other Metals in Argentiferous Ores. CHARLES WHITE MERRILL, *et al.* *Economic Paper* 10, *United States Bureau of Mines* (1930) 29 pages.
Silver-bearing ores which produce 91% of the world's silver also produce 85% of the world's gold, 69% of the lead, 66% of the copper and 46% of the zinc. Silver contributes 10.4% to the gross value of this group. The % of the total world's silver production contributed by ores whose silver content represents the indicated proportion of the value of the ore is as follows: silver 0–10% of ore value, 12.3% total silver production; 10–20, 21.0; 20–30, 10.3; 30–40, 9.0; 40–50, 5.0; 50–60, 1.7; 60–70, 5.4; 70–80, 8.3; 80–90, 16.9; 90–100, 10.1. More than 1/2 the total silver production is from ores to which silver contributes less than 1/2 its value, and 1/2 from the 0 to 20% classes. A table shows the % of value contributed by each of the other metals in the above classes. Analyses of the ores by countries and districts are given. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Colorado in 1928. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1928, Part 1, *United States Bureau of Mines*, October 21, 1930, pages 817–872.
The gross value of the gold, silver, copper, lead and zinc recovered in Colorada in 1928 was $16,375,355, a decrease of 3.5% from 1927. There was a nominal increase in the output of gold, an increase of 10.5 % in silver production, an increase of 67% in copper output, a decrease of 26% in the production of lead and a decrease of 5% in zinc. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Arizona in 1928. C. N. GERRY. *Mineral Resources of the United States*, 1928, Part 1, *United States Bureau of Mines*, Oct. 15, 1930, pages 761–815.
In 1928 the mines of Arizona produced gold, silver, copper, lead and zinc worth $114,300,381, the largest production of these 5 metals of any state. Copper represented 92% of the total value. The total increase of $15,509,424 over 1927 was due almost entirely to copper as the output of gold, lead and zinc decreased 4, 28 and 50%, respectively. The quantity of silver decreased slightly, but the value increased more than 2%. Of the total copper produced, 52% was obtained from concentrates, 37% from crude ore smelted, and 9% from ore leached. AHE(16)

PLANTS & LABORATORIES (17)

Layout Aids Non-Ferrous Production. EDWIN BREMER. *Foundry*, Vol. 58, July 15, 1930, pages 48–51, 84.

Describes plant of the American Manufacturing Co., Dayton, Ohio, manufacturers of non-ferrous castings. Casting range from 1 oz. to 1000 lb. and include the well-known No. 12 and other Al alloys, the 85–5–5–5, 88–10–2 and 80–10–10 bronzes, Mn bronze, yellow brass and acid resisting bronze. Foundry has a capacity of 1,000,000 lbs. of castings a year. Red metals and Al cast in separate foundry bays. Well illustrated. VSP(17)

Produces Cores with Speed and Accuracy. F. B. PELCHER. *Foundry*, Vol. 58, July 1, 1930, pages 88–91.

Describes coremaking at the Kenosha, Wis. foundry of the Nash Motor Co. Equipment includes 7 continuous gas fired ovens—3 horizontal and 4 vertical. Each of the horizontal ovens has a capacity of from 60 to 80 core racks. Two ton crane distributes the sand. Core breakage is negligible as a result of a continuous conveyor system. Economy in core baking in horizontal ovens. Tabulates data on vertical core ovens. VSP(17)

Battelle Institute Houses Several Metallurgical Researches. *Iron Age*, Vol. 126, July 10, 1930, pages 89–91, 131.

Established by the will of the late Gordon Battelle. It is a non-profit agency with ample funds. Dr. H. W. Gillett is director, with C. E. Williams as associate director supervising work on fuels, ores smelting, and O. E. Harder in charge of work on metals and alloys. The L-shaped building is erected on the outskirts of Columbus, facing Ohio State University's farm. Its proximity to the University is advantageous. Several investigations are already underway, financed by industrial organizations. VSP(17)

Constant Growth Marks History of Sievering Plating Plant. *Metal Industry* (N. Y.), Vol. 28, June 1930, pages 269–270.

Oldest jobbing plant in New York adds 10,000 ft.^{2} of space. New 5000 ampere generator has been installed for Cr plating. VSP(17)

Galvanizing Works of Messrs. Baldwins, Limited, at Hereford. *Iron & Coal Trades Review*, Vol. 120, Jan. 10, 1930, page 47.

Describes the new galvanizing plant which was opened Jan. 1, 1930. The plant handles about 200 tons of material per week. RHP(17)

The Heat-Treatment of Locomotive Parts. W. A. STANIER. *Proceedings Institution of Mechanical Engineers*, No. 5 (1929) pages 1069–1073.

Abridged from an address delivered before the Western Branch in Bristol on Dec. 11, 1928. Briefly describes a metallurgical plant at Swindon. (The plant is not named.) Gives a chart diagram showing heating and quenching temperatures for the heat-treatment of straight carbon steels. Photomicrographs illustrate the structure of axle steel under various conditions. RHP(17)

At the Dunswart Iron and Steel Works. *South African Mining & Engineering Journal*, Vol. 41, March 8, 1930, pages 45–47.

Some of the up-to-date additions to this steel foundry are described and illustrated. AHE(17)

MACHINERY & SUPPLIES (18)

Welding Reduces Production Times for Jigs from Weeks to Days. J. R. WEAVER (Westinghouse Elec. & Mfg. Co.). *Electric Journal*, Vol. 27, Sept. 1930, pages 506–508.

In addition to time saving a reduction in cost of about 25% is secured where machine jigs are made by arc welding. The jig parts are assembled by a mechanic, properly squared and tack-welded, sufficiently to hold them together and then turned over to the welder. The jigs are normalized by heating to 1000° F. and allowed to cool in the air. WHB(18)

New Electroplating and Cleaning Conveyor. *Brass World*, Vol. 26 Sept. 1930, page 238.

Sargent & Co. of New Haven, Conn., have marketed an automatic machine for electroplating, pickling and cleaning in large scale production. Speed, quality of work and economical operation are claimed for the machine. Two illustrations are shown. WHB(18)

New Acetylene Generators for Gas Welding. (Les nouvelles centrales a acetylene pour la Soudure Autogene.) *Journal du Four Electrique*, Vol. 39, May 1930, pages 176–177.

In large acetylene generators producing 50–100 m.^{3} per hour carbide falls in water giving relatively cold gas. The mud, 20–30 liters per kg. of carbide, is continuously ejected at the bottom. The feed is automatic. JDG(18)

MISCELLANEOUS (20)

Influence of the Quality of the Surface on the Corona Losses of Aluminum and Copper Cables. (Einfluss der Oberflächenbeschaffenheit von Aluminium und Kupferseilen auf die Koronaverluste.) SCHMITT & KRINES. *Electrotechnische Zeitschrift*, Vol. 51, Mar. 27, 1930, page 468–469.

Tests were made with old and new cables. It was found that the losses of old cables were always lower than those of new cables which is ascribed to the fact that the old cables have a smoother surface due to wear. The roughness of the new cables acts like points, which is more pronounced in the harder copper than in the soft aluminum. Ha(20)

Plastic Torsion—An Experimental Determination of Stress Distribution in a Bar which Has Been Twisted to the Limit of Plasticity. A. NADAI. *Preprint American Society of Mechanical Engineers*, Dec. 1–5, 1930, 15 pages.

The author compared the distribution of stress with the position of the thin layers of slip observed in the etched cross-sections of twisted steel bars. See *Metals & Alloys*, Vol. 1, May 1930, page 527. (20)

Developments in Steel Mill Lubrication. *Lubrication*, Vol. 16, Oct. 1930, pages 109–120.

This article considers the automatic handling of lubricants in the rolling mill. Operating conditions of gears and pinions, table roll drives, roll necks, the screw-down are considered in detail. Pressure lubricators are illustrated. (20)

Chemical Reactions in Flotation. ARTHUR F. TAGGART, T. C. TAYLOR & A. F. KNOLL (Columbia University). *Technical Publication* No. 312, *American Institute of Mining & Metallurgical Engineers*, 1930, 33 pages.

Flotation with soluble reagents is due to simple chemical reactions between reagents and compounds occurring on the surface of the particles affected. Experimental evidence to uphold this deduction. 37 references. JLG(20)

Scrap Zinc as a Precious Metal Precipitant. E. T. ELLIS. *Metal Industry* (London), Vol. 37, July 18, 1930, pages 53–54.

Zn scrap can be used in the precipitation of Au from waste solutions. It can also be used for treatment of double salt solutions, especially those containing gold cyanide with potassium cyanide. Scrap Zn is a precipitant for mixed gold effluents. Scrap Zn is also useful as a Pt precipitant. Introduction of scrap Zn into a solution containing soluble Ag will lead to decomposition of Ag in a metallic state. Recovery of Zn from effluents is accomplished very easily. VSP(20)

Qualifications and Duties of Open-Hearth Melter. MARTIN J. CONWAY (Lukens Steel Co.). *Iron Age*, Vol. 126, July 10, 1930, pages 78–79.

Two men are required to work an open-hearth furnace. Besides there must be a melter and a foreman. Outlines duties of each. VSP(20)

Reliability of Fusible Tin Boiler Plugs in Service. JOHN R. FREEMAN, JR., J. A. SCHERRER & S. J. ROSENBERG. *Metal Industry*, Vol. 36, May 9, 1930, pages 501–503; May 16, 1930, pages 532–533.

Condensed from Research Paper No. 129, U. S. Bureau of Standards. Gives results of tests conducted on 150 plugs. See *Metals & Alloys*, Vol. 1, March 1930, page 431. VSP(20)

Liege Congress. (Le congres de Liege.) LEON GUILLET. *Revue de Metallurgie*, Vol. 27, Aug. 1930, pages 393–397.

A brief outline of activities of the Sixth Congress of Mining, Metallurgy and Applied Geology held at Liege on June 22–28, 1930. JDG(20)

What Goes Out in Your Waste Cans? CHARLES O. HERB. *Machinery*, Vol. 36, July 1930, pages 841–847.

Describes the salvage work done by the by-products department of the A. C. Spark Plug Co., Flint, Michigan. Everything which will yield a profit is saved. This includes much metallic material: steel borings, turning chips, etc. Greater saving has been effected by keeping the scrap of different compositions separate as well as of different metals. Lead hammers are reclaimed. Solder dippings are remelted and cast into bars. Tool steels are separated by spark testing. RHP(20)

The Cross-sectional Resistance of the Oxide Film of Glow-Cathodes. (Zum Querwiderstand der Oxydschicht von Glühkathoden.) JULIUS KROCZEK & ERNST LUEBCKE. *Wissenschaftliche Veröffentlichungen aus dem Siemenskonzern*, Vol. 9, No. 2 (1930) pages 252–261.

The magnitude of the resistance which the electrons have to overcome in their emission from the core through the oxide film was determined by the cooling effect during emission of the cathode and the emission energy could be determined simultaneously by making up the energy balance. The theory of the problem is discussed in detail and the practical measurements are described. Ha(20)

The Aluminum Electrolytic Condenser. R. E. W. MADDISON (International Standard Electric Corp.). *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 8, July 1929, pages 29–55.

A list of 39 references is appended. Discusses the general theory of electrolytic condensers and gives the results of experimental work with aluminum electrolytic condenser. RHP(20)

Preparation of Metal Powders by Electrolysis of Fused Salts. Pt. 1. Ductile Uranium. F. H. DRIGGS & W. C. LILLIENDAHL. *Metal Industry* (London), Vol. 37, July 25, 1930, page 84.

Abstract of paper read before the American Chemical Society in Atlanta, April 7–11, 1930. VSP(20)

Calculation of the Temperature Course in Heating Processes. (Zur Berechnung des Zeitlichen und Oertlichen Temperaturverlaufes beim Glühvorgang.) A. SCHACK. *Stahl und Eisen*, Vol. 50, Sept. 11, 1930, pages 1289–1297.

Report 142 of the Heat Committee of the Verein deutscher Eisenhüttenleute. The characteristics of uniform and non-uniform heat flow and temperature conductivity are described as well as the present known practical solutions of the equation of non-uniform heat flow are given. The heat flow in bodies of different shape is calculated for 2 different cases, namely, for a sudden change of temperature of the surface and for a body which is suddenly subjected in a heat transferring medium to a temperature differing from that of the body. The temperature of the heat transferring medium is kept constant in this case. The soaking is in reverse proportion to the first power of the diameter of bodies which have excellent soaking properties due to a high temperature conductivity and a small thickness of the heated pieces. The soaking decreases proportional to the square of thickness in bodies with poor soaking properties. (Low heat conductivity or large thickness.) Diagrams are drawn and interpolated for the calculation of the temperature course in balls, cylinders and plates according to the calculation by Williamson, Adams and Groeber. The cooling conditions in a shaft 1 m. in diameter and 20 m. long, are calculated when cooled in air. A new approximate calculation method is developed for the heating of a 0.3 m. thick plate from one side only. A supposed heat transfer number and a suitable temperature of heating medium must be chosen in this case. GN(20)

The Effects of Chromium-Nickel Heating Wires on Ceramic Supports. (Ueber die Einwirkung von Chromnickel-Heizdrähten auf keramische Wicklungsträger.) E. ALBERS-SCHOENBERG & M. BICHOWSKY. *Elektrotechnische Zeitschrift*, Vol. 50, Dec. 19, 1929, pages 1837–1840.

The well-known destruction of heating wires and their ceramic supports is studied by intentional production of unfavorable operating conditions and observation of the fusing phenomena. The occurrence of colored deposits and melting-spots are explained chemically and electrically. This leads to some surprising facts, i. e., the purely thermal formation of chromic acid anhydride on the surface of red-hot chromium-nickel wire and the movement of oxide fog in an electric field. The authors conclude that it will hardly be possible to always find one suitable to ceramic material; cases have to be studied individually and the shape of the ceramic support is of eminent importance for the life of the combined unit. Ha(20)

On the Attack of Metals by Insects. (Uber den Angriff von Metallen durch Insekten.) O. BAUER & O. VOLLENBRUCK (Kaiser Wilhelm Institut für Metallforschung, Berlin-Dahlem). *Zeitschrift für Metallkunde*, Vol. 22, July 1930, pages 230–233, 7 references; *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 13, 1930, pages 3–7.

The proof was furnished that certain species of beetles are able to attack metals. The attack is of a mechanical nature. By hard and sharp organs the beetles gnaw and drill themselves through the metal by tearing off small chips. The harder the metal the more difficult the work for the insect. For both species investigated, *Dermestes peruvianus* and *Dermestes lardirius*, aluminum and zinc seem already to offer too large a resistance, whereas lead and, with greater difficulty, tin are destroyed. EF(20)

On the Self-Ignition of Blast Furnace Dust. (Ueber selbstentzündlichen Gichtstaub.) H. ECKSTEIN. *Stahl und Eisen*, Vol. 50, Sept. 4, 1930, page 1270.

The author summarizes observations of self-igniting blast furnace dust, made in the Röchling Steel mills at Völklingen-Saar district. Whereas self-igniting blast furnace dust is generally traced to the presence of zinc dust, no clear relationship between self-ignition and zinc dust could be stated; though zinc was also in this case found to be the reason for self-ignition. It is possible that the presence of metallic iron and manganese accelerated the self-ignition. GN(20)

The Occurrence of Beryllium. (Das Vorkommen von Beryllium.) M. HOSENFELD. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 8, No. 1 (1929) pages 21–25.

Brief outline with 25 references giving location of beryl. (20)

Oxidation of Mercury Vapor on Incandescent Platinum. (Ueber die Oxidation des Quecksilberdampfes am glühenden Platin.) Y. OKAYAMA. *Zeitschrift für physikalische Chemie*, Vol. 6, Feb. 1930, pages 355–367.

The oxidation velocity of Hg-vapor in incandescent Pt was studied at low pressures. The oxidation speed is nearly independent of the vapor pressure of the Hg but increases with rising oxygen pressure according to the formula:

$$-\frac{\Delta n}{\Delta z} = \frac{\sqrt{p}}{a + b\sqrt{p}}.$$

EF(20)

Thermochemistry of Iron, Manganese and Nickel. (Beiträge zur Thermochemie des Eisens, Mangans und Nickels.) WALTHER A. ROTH. *Stahl und Eisen*, Vol. 49, Dec. 5, 1929, pages 1763–1765.

Abstract of a paper presented before the Chemists' Committee of the Verein deutscher Eisenhüttenleute. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 431. (20)

The Production of Very Pure Mercury. (Die Herstellung sehr reinen Quecksilbers.) H. VON STEINWEHR & A. SCHULZE. *Zeitschrift für Instrumentenkunde*, Vol. 49, Nov. 1929, pages 566–567.

The authors describe the methods for the purification of mercury for scientific purposes as applied in the Physikalisch-Technische Reichsanstalt-Berlin. After agitating with diluted nitric acid and benzene or alcohol, the metal is filtered through leather or a porcelain filter and then submitted to distillation according to the method of Hulett which was modified. Electrolytic purification is superfluous whereas the storage causes trouble. Preservation in evacuated gas bottles proved to be the best method. EF(20)

Chrome Plating and Anodic Oxidation. *Metallurgia*, Vol. 2, May 1930, page 3.

An investigation by H. M. Medical Inspectors of Factories of 200 persons engaged in chromium plating and anodic oxidation processes proved that these processes are dangerous. In more than half of the workers the mucous membrane of the nose had been affected by the spray generated. The risk can only be eliminated by efficient exhaust ventilation. JLG(20)

The Rarer Metals in Glass. *Vancoram Review*, Vol. 1, Oct. 1930, pages 149–152.

The application of the rarer metals in glass is briefly discussed. (20)

Electrically-Generated Hydrogen Serves as Descaling Agent. *Iron Trade Review*, Vol. 86, March 27, 1930, page 67.

It is claimed that the Bullard-Dunn process of cleaning metal surfaces by the action of cathodic hydrogen removes only scale, oxide and foreign matter, without attacking the original metal regardless of the time of immersion. MS(20)

The Plastic State of Metals. A. NADAI. *Metal Industry* (London), Vol. 36, April 11, 1930, pages 405–406.

Abstract of paper read before the American Society of Mechanical Engineers in New York. See *Metals & Alloys*. Vol. 1, May, 1930, page 527. VSP(20)

Steel Plant Lubrication Problems. W. A. JAMES. (Lackawanna Plant—Bethlehem Steel Co.) *Iron Age*, Vol. 125, May 15, 1930, pages 1455–1456; *Iron & Coal Trades Review*, Vol. 121, July 25, 1930, page 120.

Includes discussion. Abstract of paper before the American Iron and Steel Institute, May 9. See *Metals & Alloys*, Oct. 1930, page 804. RHP+VSP(20)

Contributions to the Thermo Chemistry of Iron. (Beiträge zur Thermochemie des Eisens.) W. A. ROTH, H. UMBACH & P. CHALL. *Archiv für Eisenhüttenwesen*, Vol. 4, Aug. 1930, pages 87–93; *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1331–1332.

Report No. 78 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. The heat of formation and heat of transformation of some iron compounds which have been determined in a calorimeter in a former investigation (*Archiv für Eisenhüttenwesen*, Vol. 3, 1929, pages 339–346) have been checked by dissolving these compounds in hydrochloric acid. The method is described in detail; the difficulties in dissolving iron ores are discussed and the necessary correction values are given. The heat of formation of FeO was determined as 64.2 kg. cal. ± 0.1 kg. cal., the heat of formation of magnetite from Fe_2O_3 and FeO as 7.0 kg.cal. the heat of formation of fayalite as 8.1 kg. cal. and the chlorination heat of Fe_2O_3 as 7.4 kg. cal. GN(20)

Sizes and Tolerances for Metal Fits. C. R. REIMAN. *Preprint American Society of Mechanical Engineers*, Dec. 1–5, 1930, 10 pages.

This paper discusses comparisons of metal fits. The matter of working fits being left in many plants largely to the opinion and ability of the workman, the need of standardization in consequence asserts itself as organizations are entitled to records of these matters. The comparisons of the practice of other standards and the analysis that influences the conclusions are given in a simple way. Simplification for better understanding is aimed at, and the need for a standard common practice throughout the industry is recognized. Controlling influences are considered, and various features for which advantages are claimed are stressed. The use of the basic size to under hole system, and the basic shaft are discussed. Different kinds of fits are compared, and the reasons for differentiating between straight shafts and turned studs are given. (20)

Laws Governing the Natural Occurrence of Metals. (Gesetzmässigkeiten im natürlichen Vorkommen der Metalle.) G. BERG. *Metallwirtschaft*, Vol. 9, Jan. 3, 1930, pages 1–7.

Includes 10 references. Discusses the relation between geological formations and the physical chemistry of minerals and gives reasons why certain elements are usually found together in the same mineral groups. Discusses the effect of freezing points, boiling points and vapor pressure of different constituents of a molten mass, change of solid solubility with temperature. Metallography, X-rays and atomic structure are made use of in the study. The exterior of the earth is composed principally of silicates, the center of iron and nickel, with an intermediate layer consisting probably of sulphides. Isomorphism and solubility depend on atomic volume. Effect of primary and secondary crystallization. Illustrations are given of Ni, Co, Cu, Fe, Mn, Pt, Pd, Au and Sn. CEM(20)

FOUNDRY PRACTICE & APPLIANCES (22)

Continuous Electric Melting and Other Gray Iron Practice. *Iron Age*, Vol. 126, July 10, 1930, pages 87–88.

A topic of discussion at one of the sessions at Cleveland before the American Foundrymen's Association in May. An outline of practices and results at the Beach Foundry, Ltd., Ottawa, Canada was given in a paper by N. L. Turner. Includes the cost of electric Fe per ton and analysis of stove plate gray Fe. A method of briquetting cast Fe borings to a density of 70 to 85%, without use of binder was described by Harry Rayner. Other problems taken up were cupola operation, foundry nomenclature and alloy Fe and heat treatment. VSP(22)

Incorrect Weighting of Moulds. "VALLISHE." *Foundry Trade Journal*, Vol. 42, May 8, 1930, pages 345–346.

Study of weighting and clamping of molds includes several factors: (1) Type of castings and sizes; (2) size and weight of box, (3) area and weight of sand when rammed, (4) head pressure, (5) number of runners, and (6) buoyancy. Determination of lifting pressure on a core. Contains table giving pressure on round or square cores. VSP(22)

Methods of Moulding Castings for Stoves, Heating Apparatus and Various Builders' Castings. H. MAGDELENAT. *Foundry Trade Journal*, Vol. 43, July 10, 1930, pages 24–27.

French exchange paper presented before the Institute of British Foundrymen. Description is given of methods of molding a pedestal stove, cooking range parts, skylight and a sink. The Rosieres-Bachon patent continuous molding machine, constitutes a complete molding shop. Used for repetitive production of flat and slight relief castings. The chief advantages of this machine are: (1) ramming of the sand by multiple rollers; (2) method of effecting the movement of strippers and the conveyor trolley in an endless circuit. VSP(22)

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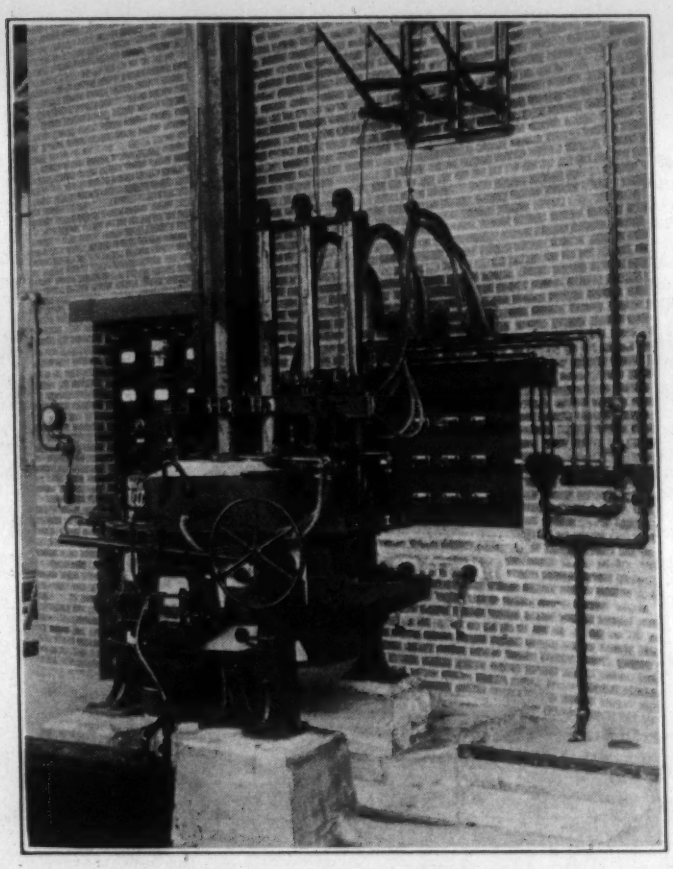

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The Founding of Bronze. (La Fonderie de Bronze.) L. THIBAUT. *Fonderie Moderne*, Vol. 23, Oct. 25, 1929, pages 501–503.
The historical development of bronzes is outlined. Special attention is called to the value of nickel-containing bronzes. (22)

Iron and Steel Foundry Practice. BEN SHAW. *Metallurgia*, Vol. 2, Aug. 1930, pages 135–136, 155; Vol. 3, Nov. 1930, pages 20–22, 34.
Discusses reasons why steel is more difficult to cast than iron. Briefly discusses the influence of various alloying elements on steel castings. Molybdenum is particularily advantageous as an alloying element. JLG(22)

Advantages of Electrical Melting Furnaces. FRED W. FRIESE. *Metallurgia*, Vol. 2, Aug. 1930, page 128.
In Brazil it is more economical to melt copper alloys in an electric furnace than in a crucible furnace. Some costs are given. JLG(22)

Synthetic Cast Iron Made in Electric Furnace. NATHUSIUS. *Foundry Trade Journal*, Vol. 42, June 5, 1930, page 423.
Process is based on the fact that carburization of Fe takes time and cannot be accelerated by increasing the supply of electricity. Describes a furnace being used by Brown-Boveri. Gives a table showing mechanical properties of some melts. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 683. VSP(22)

Some Recent Developments in German Foundry Practice. S. G. WERNER. *Foundry Trade Journal*, Vol. 42, April 10, 1930, pages 272–276.
Paper read before London section of the Institute of British Foundrymen. Problems which have been dealt with are: the behavior of cast iron and steel castings at high temperatures, growth of cast iron, machinability of steel and cast iron and various others. The Heinrich Lanz. A. G. of Mannheim have done pioneer work on pearlitic iron. To overcome difficulties arising when producing high temperatures the oil fired Wüst furnace was developed. Another furnace which has been quite a success is the Brackelsberg furnace. Other developments taken up are sand research, fettling and time studies. VSP(22)

The Future of the Side-Blown Converter in the Steel Industry. J. DESCHAMPS. *Foundry Trade Journal*, Vol. 43, July 3, 1930, page 14.
From a paper read before the Institute of British Foundrymen. The question of the future of the side-blown converter is of interest to steel founders. Object is to show why the number of these furnaces in steel foundries is likely to increase in the future in view of the advantages this process presents. Converter process has the advantage over the open-hearth and electric process owing to greater flexibility. For a given temperature side-blown converter steel has greater fluidity. Elimination of occluded gases and silicates is easier. Although cheaper than electric steel it is costlier than open-hearth. VSP(22)

Casts Pipe Centrifugally in Sand Molds. PAT DWYER. *Foundry*, Vol. 58, July 1, 1930, pages 98–102.
This is the 4th of a series of articles. Describes method employed by the American Cast Iron Pipe Co., Birmingham, Ala. The most spectacular achievement has been the introduction and development of the monocast centrifugal process for making cast iron pipe. Ovens are heated with by-product gas. Pipes of 4, 6, 8, 10 and 12 in. in 16 ft. lengths are produced. Green sand molds are used. Cupolas are charged mechanically. VSP(22)

Superheating Cast Iron. P. BARDENHEUER & K. L. ZEYEN. *Foundry Trade Journal*, Vol. 42, June 5, 1930, pages 422–423.
Translated from *Die Giesserei* 1929, No. 33. See *Metals & Alloys*, Vol. 1, Dec. 1929, page 293. VSP(22)

Pressure Die-Cast Aluminium Alloy Test Pieces. J. D. GROGAN. *Engineer*, Vol. 150, Sept. 19, 1930, pages 318–319; *Engineering*, Vol. 130, Sept. 12, 1930, pages 345–347.
Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 855. LFM(22)

The Fundamentals of Brass Foundry Practice. R. R. CLARKE. *Metal Industry* (London), Vol. 36, June 13, 1930, pages 633–634.
Oxidation and gasification is very prominent in Cu. To overcome this, and where electrical requirements are not high 2% Zn and trace of P is added. Other substances added are Si and Mg. Charcoal is the most reliable aid in Cu manipulation. In pouring, hot metal is better than cold. Difficulties encountered in Cu molding: (1) high and local shrinkage; (2) obtaining clean-metal. Cu has a tendency to congeal in its centers of bulk. Often Cu riser top surface shows no shrinkage, while underneath heavy shrinkage is in evidence. Gating point of Cu should be where metal will be delivered with least commotion and mold punishment. Mechanical agitation works up and releases dross. VSP(22)

Casting Monel Metals. W. J. REARDON. *Brass World*, Vol. 25, Dec. 1929, page 291.
Some practical information for making monel metal castings. WHB(22)

Malleable Cast Iron. G. R. SHOTTON & G. H. HALL. *Foundry Trade Journal*, Vol. 42, May 29, 1930, pages 399–404.
Read before Birmingham Junior Section Institute of British Foundrymen. Malleable castings were first produced in Europe in 1722 by Réaumur. The black-heart-type malleable cast Fe was discovered in America by Seth Boyden. Difference between white-heart and black-heart type is that the former obtains its malleability from oxidation of C, and the latter by graphitization of C. Freezing of white Fe. The analysis of white-heart cast Fe is: Total C 3.20–3.80, Si 0.45–0.75, Mn 0.30–0.40, S 0.20–0.35 and P below 0.10%. The analysis of black-heart type of white cast Fe is: Total C. 2.30–2.60, Si 0.75–0.90, Mn 0.25–0.35, S 0.03–0.06 and P below 0.20% Effects of common elements. The effect of Si is to favor graphitization. S has a retarding effect on graphitization, and is the controlling factor between varieties of malleable cast Fe. Mn should be present in the atomic ratio 1.72 times the % of S. In black-heart type Fe it should be about 0.2–0.25%. P can be as high as 0.2% but usually above 0.1% in white-heart Fe, and 0.15% in black-heart Fe. The control of melting operations must be rigid. In production of malleable Fe the oxidation is kept as low as possible. Malleable foundry differs in few respects from gray Fe foundry. Before annealing castings are freed from sand, they are also fettled, and all gates broken off. They are packed with ore or slag to keep from warping due to the high temperature. Black-heart-type malleable is much superior to white-heart in every respect. Its physical properties can be altered to serve many diverse needs. VSP(22)

The Founding of Bronze Gear Blanks. FRANCIS W. ROWE. *Foundry Trade Journal*, Vol. 42, June 19, 1930, pages 449–450, 464; June 26, 1930, pages 469–470.
Paper presented before the Institute of British Foundrymen. The value of bronze for gear blanks is due chiefly to its low coefficient of friction when working against hardened steel. The material used being usually a tin phosphor-bronze with from 10.5 to 13% Sn and 0.1 to 0.5% P. The hard particles of α-δ eutectoid give the resistance to wear and hardness. The soft Cu-Sn solid solution give resiliency. Close control of raw material is essential. Melting as practiced by author is done in a battery of coke fired reverberatory furnaces supplemented by pit-fire furnaces and induced-draft tilting furnaces for special heats. Gear blanks are usually cast centrifugally. Sand casting, due to slow rate of solidification has a low density. Casting with a ring chill is an improvement over sand casting. It has however several drawbacks. Gives advantages of centrifugal casting and method of procedure. Discusses also other types of gear castings. VSP(22)

On the Influence of Colloidal Ferric Hydroxide upon the Properties of Moulding Sand. E. TAKAHASI. *Kinzoku no Kenkyu*, Oct. 1930, pages 552–562.
Molding sand containing 10% water was found to have maximum strength. The effect of ammonia (or alkalies) upon the strength of the molding sand was not noticeable. But the effect of hydrochloric acid was very powerful and the strength increased by about 25% at 0.02N. The addition of colloidal ferric hydroxide increased the gas permeability according to ramming condition. Synthetic molding sand was made and tested as follows: Silica sand of the size 0.1–0.25 mm. was washed with hydrochloric acid. This sand has a negative charge when it is in contact with water. Colloidal ferric hydroxide solution (ferric hydroxide solution has positive charge) was filtered by the sand layer. And thus the sand was coated by ferric hydroxide film. One part of refined clay powder was ground with 3 parts of dried ferric hydroxide. One part of this mixed powder was ground with 10 parts of clay powder. Synthetic molding sand was then made with the sand and 10% of the clay mixture. The strength of it was about 50% greater than the molding sand which consists of silica sand and clay, both untreated with ferric hydroxide. The gas permeability of the former was a little less than the latter up to 17% of water content, but is greater above it. KT(22)

FURNACES & FUELS (23)

The Economics of Heat Treating. ROBERT M. KEENEY (Connecticut Light & Power Co.). *Transactions American Society for Steel Treating*, Vol. 17, May 1930, pages 615–630.
A paper presented before the New York Chapter of the Society, Dec. 1929. The selection of fuel for a heat treating application is an economic problem involving not only the B.t.u. but also the effect of the use of the various fuels on the amount and quality of the work produced. The author discusses conditions local to the Connecticut valley as applying various fuels to annealing, carburizing and hardening of steel and the annealing of non-ferrous metals. Each heat treatment has its best fuel for a given locality and condition, and the author warns equipment salesmen and industrial executives against a too enthusiastic reception of any one fuel as a universal heating medium. WLC(23)

Heat Treatment Furnaces. A. G. LOBLEY. *Automobile Engineer*, Vol. 20, March 1930, pages 110–111.
Abstract of a paper recently presented to the Coventry Branch of the Institution of Production Engineers. Two primary advantages of the electric furnace are exactitude of control, and flexibility. These are especially important in the automotive industry. Depending on the operation. Electric heating may in some cases be as cheap as coal and cheaper than gas. Nickel chromium may be used up to a temperature of 1100° C. This alloy is almost universally used to-day by electric furnace makers. Discusses electric furnace construction practice. RHP(23)

Possibilities of Electric Furnace. (Les possibilities du four electrique.) PAUL MARTHOUREY. *Journal du Four electrique*, Vol. 39, July 1930, pages 247–248.
Generalities. JDG(23)

Wider Use of the Soderberg Self-Baking Electrode. JAMES SILBERSTEIN. *Iron Age*, Vol. 126, July 10, 1930, page 94.
First self-baking electrode was installed in Norway in 1919. Soderberg electrode is molded to shape by ramming soft preheated C paste into a cylindrical sheet steel container. When electrode is installed, furnace must be run with coke for first 8 or 10 hours and at low electrical load. No ore should be charged against electrode. Savings by Soderberg electrode are due to absence of butts and less air corrosion of electrode. VSP(23)

The Selection of Fuels for Heating Coke Ovens. H. L. CAMPBELL. *Foundry Trade Journal*, Vol. 43, July 3, 1930, page 6.
Abstract of article from Industrial Gas. Owing to difficulty of controlling temperatures in oven fired with coal, this fuel is not adapted to heating core ovens. Powdered coal burns at very high temperatures; provisions must be made for lowering the temperature before they enter core ovens. Disadvantage of using coke is the difficulty of controlling the temperature and atmosphere throughout interior of core ovens. Cites also disadvantages of fuel oil and electric heating. Industrial gas is suited to heating at temperatures used for baking cores. Gives advantages of industral gas. VSP(23)

Control of Mixed-Gas Furnaces. KARL A. MAYR. *Iron Age*, Vol. 126, July 24, 1930, pages 225–228.
Chiefly a translation of Karl Loebbecke's article in *Feuerungstechnik*, Vol. 17. Two methods of burning gas in one furnace: Gases may be mixed before entering furnace, or individual gases may be fed by separate burners or group of burners. Efficient operation requires exact air proportions. The Arca multiple-gas control secures automatically the supply of combustion air by the operation of a single damper for 2 or 3 different fuels used in one combustion apparatus. Gives detailed description of operation of the apparatus. To adjust proper amount of combustion air, the amount of gas supplied is measured, and also the amount of gas to be fired. Gives calculation of air requirements. VSP(23)

Sklenar Midget Furnace. *Foundry Trade Journal*, Vol. 42, May 1, 1930, page 322.
Describes furnace developed by the British Reverberatory Furnaces, Ltd. It is a 300 lb. brass capacity, which eliminates crucibles and tap-holes. It preheats charges, recuperates waste gases and is mechanically emptied by tilting. Oil firing is standard but coke fired furnaces are available. Gives experimental data. VSP(23)

The Rotatory Furnace for Iron Founding. *Metallurgist*, Aug. 1930, pages 119–120.
A general discussion of the paper by Auguste Le Thomas in the May issue of the *Revue de Metallurgie* in which the author compares the rotating cylindrical furnace for melting cast iron for foundry purposes with the old cupola type. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. VVK(23)

Industrial Electric Furnaces. *Electrical Review*, Vol. 105, Oct. 18, 1929, pages 674–676; Nov. 1, 1929, pages 773–774.
Illustrations and descriptions of the "Birlec" rotating annular-hearth, box-type, and pusher-type furnaces built by the Birmingham Electric Furnaces; Metropolitan-Vickers Electrical Co., induction furnace; double-ended furnace for precious metals and high-efficiency resistance furnaces, built by Electric Furnace Co., "Lecfur" melting-pot and B.E.S. 3 and C.C.8 furnaces, built by Leeds Electrical Constructional Co., and a carburizing furnace built by Wild-Barfield Electric Furnaces. MS(23)

Coreless Induction Furnaces. (Les fours à induction sans circuit ferromagnètique.) M. GLIKSMAN. *Revue Generale de e'Electriciti*, Vol. 26, Sept. 7, 1929, pages 361–370.
Mathematical study of the influence of the frequency of the supply current on efficiency. Concludes that high frequencies are of real advantage in the case of furnaces of small capacities, such as laboratory furnaces where heating takes place by indirect induction, i. e., in a graphite crucible and not in the mass of the charge itself. For metallurgical operations on an industrial scale, commercial frequencies are suitable. MS(23)

Normalizer Improves Sheet Quality. *Iron Trade Review*, Vol. 86, March 13, 1930, page 58.

Central Alloy Steel Corp. has installed a walking-beam type continuous normalizing furnace. Unit is 130 ft. long, furnace proper being 100 ft. long, with an effective interior width of 108 in. Gross capacity is 8 tons/hr. consumes 1300 cu. ft. of natural gas per gross ton of product. It will operate satisfactorily at any temperature up to 1850° F. Work passes through furnace at 2½-10 ft. per min. MS(23)

The Utilization of Waste Heat in the Steel Industry. C. W. E. CLARKE. *Iron Age*, Vol. 125, June 5, 1930, page 1681–1684

From paper before the American Iron & Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 855. VSP(23)

The Grünewald Bright Annealing Process. (Das Grünewald-Blankglühverfahren.) R. W. MÜLLER. *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 525–527.

An electric annealing furnace is described in which the work is heated in a pot made air-tight with a lid fitted with a rubber gasket which is water cooled. The pot is supported from the top of the furnace and the work is suspended from the lid. As the pot serves only to exclude air and does not support any weight it can be made from thin sheet material instead of a heavy casting. Advantages are quicker heating and lower power consumption. The lid is fitted with a valve and during heating most of the air is driven out and the oil, which usually covers the work, forms a non-oxidizing atmosphere. After heating, the pot can be removed and another placed in the same furnace. During cooling a vacuum forms in the pot. The process can be used for the bright annealing of any metals up to 750° C., especially between rolling and drawing operations. CEM(23)

Orientation of metallurgical coke industry in Central Europe. (Orientation actuelle de l'industrie du coke metallurgique dans l'Europe Centrale.) CH. BERTHELOT. *Revue de Metallurgie*, Vol. 27, Sept. 1930, pages 486–500.

Points out the lagging of France in the development of efficient coking plants following Central European lines. Enumerates the conditions leading to efficiency, both in the construction of ovens and coking methods as already adopted in Germany and Czechoslovakia. Figures of performance and of the relation between design and efficiency are given. Considerable attention is paid to the influence of the peculiarities and faults in design. JDG(23)

A New Universal High-Vacuum Furnace. (Eine neue Universal-Hochvakuum-Ofenanlage.) *Electrotechnische Zeitung*, Vol. 51, Aug. 7, 1930, pages 1146–1147.

Short description of a furnace for laboratory and industrial use made by the Elektro-Schaltwerk A.-G., Goettingen, Germany. The heating elements are of molybdenum wire, the furnace is water-cooled and can be tilted, and has three exchangeable covers. It takes 25 minutes to obtain a vacuum of 40×10^{-4} mm. Hg; 3 pounds of copper can be melted in 41 minutes with an energy consumption of 1.29 kwh. Ha(23)

Practical and Theoretical Heat Balance for Rotary Forging Furnaces. THEODORE F. SCHILLING (Mahr Manufacturing Co.). *Transactions American Society for Steel Treating*, Vol. 18, Aug. 1930, pages 235–249.

An analysis and comparison of 3 sizes of rotary forging furnaces using 4 different fuels are made, giving theoretical and actual values. There is a discussion of production rates of such furnaces, the selection and operation of them. WLC(23)

Artificial Atmospheres in Electric Furnaces. A. J. STRAIN. *Canadian Chemistry & Metallurgy*, Vol. 14, Oct. 1930, pages 290–292.

A process has been developed which involves the complete or partial thermal decomposition of hydrocarbons with or without steam, to produce mixtures having carbon monoxide, hydrogen and carbon dioxide as the main constituents. The relative quantities of gases in the mixture will depend upon: (1) the hydrocarbon being treated; (2) the temperature to which it is heated, and (3) the amount of steam used. The choice of raw material depends upon: (1) its availability; (2) the use to which the electrolene is to be put; and (3) its effects upon the final cost of the electrolene. The raw materials necessary for the production of electrolene are: gas, steam and electrical energy. Twelve advantages claimed for the electrolene producer over all other commercial apparatus are listed. Several tables and illustrations are included. WHB(23)

Overcoming the Smoking Habit in Oil-Fired Furnaces. F. J. GUTSCH (Southern Pacific Co.). *American Machinist*, Vol. 72, March 6, 1930, pages 417–418.

Illustrates and describes an oil-fired furnace developed by the Southern Pacific Company. Heating work may be begun within ten minutes after the oil has been ignited. Burns all of the oil and leaves no carbon deposit. In operation, the oil drops on to the sharp blast of air which breaks it up into small particles. The super heater thoroughly vaporizes the oil so the combustion is almost perfect. No smoke after the furnace is warmed up. RHP(23)

Open Hearth Control. H. V. FLAGG. *Iron & Steel Engineer*, Vol. 7, Oct. 1930, pages 480–481; discussion, pages 487–489.

Four essential factors influencing fuel economy in the open hearth operation are: (1) the fuel to be used; (2) furnace design; (3) the training of the operators; and (4) the equipment. WHB(23)

Development in Fuel Economy at Skinningrove. FRANK BAINBRIDGE. *Iron & Coal Trades Review*, Vol. 120, May 2, 1930, pages 709–711.

Abridged copy of a paper before the Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. RHP(23)

Power Production in the Steel Industry. W. E. CLARKE. *Iron & Coal Trades Review*, Vol. 120, June 27, 1930, pages 1021–1022.

Discusses the use of blast furnace gas to heat boilers and its use in underfiring. Also arrangement of burners in the furnace. Coke and coke breeze can be burned in powdered form. Waste heat boilers are of doubtful value in modern plant. Power units have greatly increased in capacity. RHP(23)

Industrial Electric Heating. XII. The Three-Phase Arc Furnace. N. R. STANSEL. *General Electric Review*, Vol. 33, Feb. 1930, pages 123–129.

This paper is one of a long series and deals with three-phase furnaces in steel making. These furnaces range from 500–5000 kv.-amp. The largest in use has 2 sets of electrodes, each supplied with a 10,000 kv.-amp. transformer. The furnace construction and complete equipment for this type are described in detail, pointing out the differences in the acid and the basic processes. The temperature limit of the furnace is the melting point of the refractory (1700° C. for silica brick). The energy distribution for the average acid melting practice is: useful 67%, heat flow through enclosures 16, heat flow through openings 7, escaping gases 5, cooling water loss 5%. The average percentage values of a number of heat balances of a 15-ton basic furnace are tabulated. Characteristics of the arc furnace circuit are discussed and graphs show that it is undesirable to operate with maximum power input because of consequent low electrical efficiency and power factor. The most desirable current in the arc depends in each case upon the characteristics of the arcs and of the charge and must be determined by trial for each furnace. Safety, electrical insulation and the possible introduction of nitrogen into the steel have been limiting factors as regards the voltage for these circuits. Comparative values of kw. input and amperes for melting periods of two hours, 1½ hrs., and 1 hr. are given. WHB(23)

Electric Furnaces with Basket Charging. (Fours electriques a chargement par paniers.) *Journal du Four electrique*, Vol. 39, August 1930, pages 292–294.

The roof and electrode holders of arc electric furnaces are made movable so that both can be removed from the furnace easily and without disconnecting either leads or water connections. The charge is placed in a basket with a removable bottom. A crane places it in the furnace from which the roof is removed. The bottom is disconnected and left in the furnace while the basket is removed. Total operation including the removal of the roof and full charging does not take more than 5 minutes. Many advantages are claimed. Two 6 ton furnaces with this arrangement averaged an extra heat a day and decrease of current consumption by 50 kwh./ton. JDG(23)

A Small Furnace for Melting Aluminum and Its Alloys. (Kleiner Flammofen zum Schmelzen von Aluminium und Aluminiumlegierungen.) ROBERT J. ANDERSON. *Metallwirtschaft*, Vol. 9, Oct. 31, 1930, pages 899–901.

Contains 2 references. An open-hearth furnace of 1 to 2½ ton capacity has the advantages of simple construction, quick melting and thermal efficiency. A 1 ton furnace is described in detail and dimensions of its parts are given. It can be oil or gas fired. The process of melting is described. It takes ½ hour to heat the furnace to 760 ° C. and 2 hours to bring a 1 ton charge of Al up to heat if the furnace is preheated. CEM(23)

REFRACTORIES & FURNACE MATERIALS (24)

Heat Losses and Durability of the Roof of Open Hearth Furnaces. (Wärmeverluste und Haltbarkeit des Siemens-Martingewölbes während einer Ofenreise.) A. SCHLÜTER. *Stahl und Eisen*, Vol. 50, Oct. 2, 1930, pages 1393–1397. 3 references.

Report 192 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Including discussion. In measuring the surface temperatures of the roof of an open hearth furnace over a long run it was found that the heat losses increase above 3 times, in percentage, of the total heat consumption of the furnace from 3.2 to 8.5%. From these measurements the actual thickness of the roof was calculated which shows that there is a decrease of the roof thickness proportional to the time. The normal wear of the roof does not depend upon the thickness of the brick, but rather depends on the velocity which which the bricks are transformed to slag. The consequences of local superheating increase with increasing brick thickness. The quality of the bricks has its bearing on the slagging. GN(24)

GASES IN METALS (25)

The Absorption of Gases by Metals. A. SIEVERTS. *Metallurgist*, Nov. 1929, pages 168–172.

A critical review of the present knowledge of the solution of gases in liquid and solid metals. See *Metals & Alloys*, July 1929, page 26. (25)

Nitrogen in Technical Iron. WERNER KÖSTER. *Iron & Coal Trades Review*, Vol. 120, June 6, 1930, page 920.

Abstract of a paper from *Archiv für Eisenhüttenwesen*, April 1930, pages 637–658. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. RHP(25)

Nitrogen in Technical Iron. (Zur Frage des Stickstoffs im technischen Eisen.) Part III. The Precipitation of Nitrogen and Carbon in the α-Solid Solution, as an Example of the Decomposition of a Twice Supersaturated Solid Solution. (Teil III. Die Ausscheidung von Stickstoff und Kohlenstoff aus dem α-Eisen als Beispiel des Zerfalles einer doppelt übersättigten festen Lösung.) W. KÖSTER. *Archiv für Eisenhüttenwesen*, Vol. 4, Sept. 1930, pages 145–150; *Stahl und Eisen*, Vol. 50, Oct. 2, 1930, pages 1401–1402.

Report 165 of the Material Committee of the Verein deutscher Eisenhüttenleute. The influence of the super-saturation of α-iron with nitrogen and carbon on the segregation of nitrogen was studied by measuring the changes of the coercive force. The annealing isotherms of a nitrogen bearing Thomas-steel, which has been quenched from a temperature below A_1, have been taken. It follows that, carbon only has its influence on the magnetic properties at room temperature, whereas the influence of nitrogen predominates at temperatures of 110° to 150° C., but the carbon predominates again at temperatures above 150° C. A strong retarding of the increase of the coercive force can be observed at 110° C. in the quenched steel, compared with a slowly cooled steel, which points to a slackening of the nitrogen precipitation caused by the carbon present. Later the coercive force increases again due to the precipitation of carbon. The increase of the coercive force due to the nitrogen precipitation decreases with increasing quenching temperature, i. e., the higher the amount of carbon in solid solution. The amount of precipitated nitrogen decreases with increasing amount of carbon in the solid solution, a constant nitrogen content provided. Thus it follows that the isothermal precipitation of an element is very much influenced by the presence of another element which is simultaneously in solution. The importance of these findings on the elucidating of the aging process of duralumin is pointed out. GN(25)

Relation of Nitrogen to Blue Heat Phenomena in Iron and Dispersion Hardening in the System Iron–Nitrogen. R. S. DEAN, R. O. DAY & J. L. GREGG (Western Electric Co.). *American Institute of Mining & Metallurgical Engineers, Transactions, Iron and Steel Division* (1929) pages 446–453.

Nitrogen increases or causes "blue-brittleness." Fe-N alloys are subject to precipitation hardening. Contains 3 references. JLG(25)

The Occlusion of Hydrogen and Nitrogen by Pure Iron and Some Other Metals. DR. ERICH MARTIN. *Metals & Alloys*, Vol. 1, Nov. 6, 1930, pages 831–835.

A correlated abstract. Measurements were made by placing the metal samples in a fused silica vessel designed to permit evacuation and introduction of a desired atmosphere. The vessel was also connected with a gas analyzer. Observations indicate that argon is not occluded by any metal, hence a series of observations were made with this gas and comparison curves are shown for H_2 and N_2 both in the presence and the absence of metal. The occlusion of hydrogen by pure iron begins about 400° C. and increases slowly up to 900° where a displacement occurs and the amount of occluded gas increases from 2.9 to 4.2 cc. Both parts of the curve may be considered to be linear but the slope in the γ-range is greater than that in the α-range. Later observations showed no occlusion of nitrogen below 900° C., but the displacement of the curve is considerably higher at the transformation point. The amount of N_2 occluded, however, decreases with increasing temperature. Very little hydrogen is occluded by chromium but the amount increases above 800° C. Up to 550° C. there was no occlusion of nitrogen by chromium. At 625° C. a reaction took place. The speed of this reaction was 270 times greater at 975° C. At 1200° C, the vapor pressure of the compound was less than 0.001 mm. Chromium increases the occlusion of nitrogen by iron considerably. The occlusion of hydrogen by molybdenum is very low especially at higher temperatures. The path of the curve has a maximum. Up to 800° C. molybdenum occludes no nitrogen. At that temperature about 2.0 cc. are absorbed. This is given up on cooling only under reduced pressure. Tungsten occludes neither nitrogen nor hydrogen. Observation on iron-silicon alloys indicate the occlusion of nitrogen in the γ-range is increased slightly. These are solid solutions. ESC(25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

A Note on Zinc-Base Die-Casting Alloys. R. LANCASTER & J. G. BERRY. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 241–245.
Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 788. (27)

Investigation of the Effects of Impurities on Copper. Part VI. The Effect of Phosphorus on Copper. D. HANSON, S. L. ARCHBUTT & GRACE W. FORD. *Journal of the Institute of Metals*, Vol. 43 (1930) pages 41–72.
Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 788. (27)

Formation of Graphite; Influence of Phosphorus. KIEL & MITSCH. *Foundry Trade Journal*, Vol. 42, April 10, 1930, page 268.
Abstract translation of article in *Stahl und Eisen*. See *Metals & Alloys*, Vol. 1, Dec. 1929, page 290. VSP(27)

The Effects of Phosphorus on the Strength of Admiralty Gun-Metal. H. C. DEWS. *Engineer*, Vol. 150, Sept. 26, 1930, pages 336–337.
Abstract of paper read before the Institute of Metals, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. LFM(27)

Influence of the Composition on the Life of Annealing Pots. (Einfluss der Zusammensetzung auf die Haltbarkeit von Temperöfen.) W. S. MESSKIN. *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1335–1336.
Abstract of a paper by N. G. Girschowitsch in *Mitteilungen aus dem Institut für Metallforschung in Leningrad (Russian)* Report No. 5, 1930, pages 8–36. The influence of some additional elements on the life of annealing pots was studied with reference to casting temperature, slag inclusions and blow holes. The life decreases with decreasing C content, reaching a minimum at 2.8% C and increasing again at still lower C contents. The amount of uncombined C should not exceed 1%. Si increases the life essentially, but should not amount to more than about 0.7%. The influence of Mn does not amount to much, though it decreases the impairing influence of S. S should not amount to more than 0.2%. P is most dangerous; in absence of special elements P should not be higher than 0.3%. Cr in small additions is favorable, neutralizing the unfavorable influence of P. More than 0.6% Cr, however, is not advisable due to an increasing of brittleness. GN(27)

The Effect of Carbon on the Transformation Points and Hardness of 12 Percent Chromium Steels. TAKEJIRO MURAKAMI & YOSHIRO FUJII. *Kinzoku no Kenkyu*, Vol. 7, Oct. 20, 1930, pages 505–523.
Using 8 specimens containing about 12% chromium in constant and varied carbon content less than 2.04% carbon the change of transformation points of these alloys was studied during heating and cooling under different conditions. For the determination of the transformation points, the magnetic analysis and the dilatometric method were applied. The temperature of the A_1 transformation on slow heating and cooling gradually falls and that of the A_2 transformation gradually rises as the carbon content increases. The A_2 change takes place at a lower temperature than the A_1 change and consequently the Ac_1 change is not observable by magnetic analysis. As the maximum heating temperature is raised or the cooling rate increases, the Ar_1 change is decreased and the Ar_2 change takes place at a markedly lowered temperature. This effect is conspicuous in rather low carbon steels, the effect being small in high carbon steels if the rate of cooling is not rapid, but if the rate is more rapid than the air-cooling the lowering of the critical point is marked and the Ar_2 transformation point is lowered with increasing carbon content. The Brinell hardness of specimens cooled under different conditions or those quenched and tempered was measured. The hardness of annealed steels gradually increases as the carbon content increases. The quenched steels show a maximum hardness when cooled from 1000° either in air or in oil, and as the heating temperature further rises the hardness decreases. When the heating temperature is lower than 1000°, the hardness increases with the increasing carbon content in the cases of both air-cooling and oil-quenching. If, however, the specimens are quenched from 1200°, those with about 0.3% of carbon show maximum hardness. The effect of cooling rate is small in cases cooled in air and in oil, the self-hardening property being markedly observable in both cases. When the quenched specimens are tempered from 900° C., the low carbon steels show an increase of hardness at about 500° and rapidly decreases on further rise of temperature, while in high carbon steels, no increase of hardness at about 500° is observable. When the quenched specimens are tempered from 1100° all specimens tested show marked increase of hardness at about 500°, the increase being marked in high carbon steels and the value being far greater than that of the quenched state. The microstructure of these specimens and its change under several heat treatments was also described. TM(27)

The Effect of Phosphorus on the Iron-Carbon Alloys. (1st Report.) YOICHI YAMAMOTO. *Rikagaku-Kenkyu-Sho Iho*, Vol. 9, Oct. 1930, pages 838–851.
Using electrolytic iron, ferro-phosphorus and white pig iron, many specimens containing less than 1.7% P and less than 3.5% C were prepared and the effect of C on the solubility of P in Fe and that of P on the graphitization of cast iron were studied by microscopic observation. At first the solubility of P in the binary Fe–P system was studied using alloys containing less than 2.5% P. It was confirmed that the solubility of P in Fe at the room temperature is 1.7% P. Next the solubility of P in Fe-C-P alloys with less than 1.7% P was studied. The solubility markedly decreases as the C content increases, and in air-cooled alloys from the melt, the Fe_3P is separated by adding 0.1% P, when the C content is 1.0%. If, however, the alloys are annealed for 2 hours at 920°, the Fe_3P is diffused and the solubility of P is increased, so that 0.3% P is dissolved in high C alloys containing more than 1.5%. The fact that the solubility of P decreases as the C content increases is attributed to the decrease of ferrite, in which the Fe_3P is dissolved, unless the Fe_3C is graphitized.
The relation between the microstructure and the hardness of these alloys was also studied. In binary Fe-P alloys, the hardness is markedly increased by adding P up to 1.7% in both air-cooled and annealed specimens. In Fe-P-C alloys with more than 2.0% C and 0.5–1.0% P, the Fe_3C is graphitized by annealing at 920° and the hardness is decreased. It is also shown that the P promotes the graphitization of Fe_3C. The facts above referred to, were demonstrated by many photo-micrographs. TM(27)

INSTRUMENTS & CONTROLLERS (28)

Automatic Regulation of Electric Foundry Furnaces. (La regulation automatique de fours electriques de fonderie.) A. LEVASSEUR. *Journal du Four Electrique*, Vol. 39, Aug. 1930, pages 296–300.
Advantages and some methods of automatic control of melting furnaces used in the foundry practice. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. JDG(28)

The Automatic Reversing of Open Hearth Furnaces by the Temperature Difference Method. M. J. BRADLEY (Leeds & Northrup Co.) & J. W. KINNEAR, JR. (Carnegie Steel Co.). *Iron & Steel Engineer*, Vol. 7, Oct. 1930, pages 481–484.
Extensive studies were made on a 100-ton basic open hearth furnace to develop the best method of operating the regenerative system to definitely control the combustion rate and flame temperatures in the furnace. The study demonstrated that reversing operations can be more efficiently conducted automatically than manually. An outline shows the locations for thermocouples used in temperature study. WHB(28)

Automatic Combustion Control for Open Hearth Furnaces. R. W. SIMPSON (American Heat Economy Bureau, Inc.). *Iron & Steel Engineer*, Vol. 7, Oct. 1930, pages 485–487.
The control of combustion in the open hearth is becoming increasingly a more complex problem, following the use of 2 or more fuels at the same time. Best results are obtained by using different proportion of the fuels at different stages of the heat. Results are better with automatic control than with hand control. It is claimed that automatic combustion control will eliminate one of the variables from furnace operation which means fuel economy in amounts that will pay for the installation in a year or less. WHB(28)

Machine Control of Combustion in Metallurgical Furnaces of the Iron & Steel Industry. F. J. SHADGEN. *Iron & Steel Engineer*, Vol. 7, Oct. 1930, pages 490–497.
"A survey of the realities and an appreciation of the possibilities." The analysis has mostly the fuel aspect and its relation to greater process economy and plant efficiency. The application of machine control to open-hearth furnaces results in: (1) increase in production; (2) decrease in fuel consumption per ton; (3) longer life of furnace; and (4) better and easier metallurgical operation. Complete machine control is essential, engineering application is necessary and service and education of personnel are desirable. Includes discussion. WHB(28)

Temperature Regulators and Recorders Aid Production Processes. *Electrical World*, Vol. 96, Dec. 6, 1930, page 1037.
The Messina mill of the Aluminum Co. of America has demonstrated that automatic temperature regulators have a definite value in controlling quality of product. WHB(28)

Temperature Measurements without Pyrometers in the Metal Industry. EDMUND R. THEWS. *Canadian Chemistry & Metallurgy*, Vol. 14, Apr. 1930, pages 111, 113, 115.
Instances are pointed out where pyrometer control is non-essential. These include: (1) pouring temperatures where there is a more or less extended temperature interval determined by varying conditions, within which certain temperature-indicating reactions may take place; (2) practical working conditions may render the constant use of the pyrometer, either with thermocouple or optical, difficult; (3) where many melts are carried out per day with materials of practically similar composition, constant use of pyrometers would be tedious; and (4) the temperature-indicating reaction may be exact within a few degrees. Some good, simple methods are mentioned, such as determinations on strength of the color of the metal in a darkened room. The occasional use of pyrometers cannot be omitted except in a few cases, such as the determination of the pouring temperature of gun metal and of the ladling-out temperature of the white metal eutectic containing 54.6% tin, 41.9% lead and 3.6% antimony. WHB(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

Effect of Temperature on the Properties of Metals. (Report of Joint Research Committee on.) H. J. French, Chairman. Appendix 1, Comparative High Temperature Tests of Metals at Different Laboratories. H. C. Cross, Chairman Sub-Committee on Analysis and Correlation of Short Time Tests. Appendix 2, Some Long Time Tension Tests of Steel at Elevated Temperatures. J. J. KANTER & L. W. SPRING (Crane Company). *Preprint* for Vol. 30, Part 1, 1930, *Proceedings American Society for Testing Materials*, 40 pages.
Many details are discussed on methods of making short-time high temperature tensile tests, as to pulling speeds, temperature uniformity and measurement, strainometers and the plotting of stress-strain curves. Those making such tests will find that a careful study of the points brought out will aid in securing data that are, first, not fictitious; second, are directly comparable with the results of others. Appendix 2 gives very detailed evidence to show the value of a logarithmic method of plotting for comparing strain-hardening effects, and to bring out the fact that rates of creep are not necessarily constant. Long-continued tests often show a decreasing rate because of strain-hardening. Comparison of short-time tensile and long-time flow tests shows that, at the higher temperatures, the short-time tests do not reliably reflect the properties. At the higher temperatures, large grain size, whether obtained in cast as compared with wrought alloys, or by annealing as compared with quenching and drawing, or with rolling without annealing, tends to reduce creep. Step-loading, running awhile at one load and then increasing the load on the same specimen may give misleading results. The discussion deals primarily with methods, but the curves give much actual data on the flow properties of carbon and Ni-Cr cast steels, and on wrought carbon, Cr-Mo, Ni-Cr, stainless and 18–8 Cr-Ni steels. Some of the curves show results from observation of the same specimen for a year or more. HWG(29)

Properties of Non-Ferrous Alloys at Elevated Temperatures. C. L. CLARK & A. E. WHITE. *Preprint American Society of Mechanical Engineers*, Dec. 1–5, 1930, 7 pages.
This paper gives the results of an investigation of the properties of certain non-ferrous alloys at elevated temperatures as determined by short-time tensile and long-time creep tests. The alloys considered are of 4 groups: the nickel-copper, nickel-cobalt-titanium, copper-zinc, and copper-zinc-tin-series. The alloys are tested at temperatures both above and below their lowest temperature of recrystallization. Results indicate a superiority of the nickel-base alloys over the entire temperature range. The outstanding member of this group is Konel metal, which has short-time tensile properties at 1000° F. comparable to Enduro KA2, and the greatest creep resistance at this temperature of any alloy of which the authors are aware. Monel metal retains its properties well up to 800° F. Of the copper-zinc alloys, those containing 70% or more copper are superior to those with 60% of this element. None of these alloys can be used at temperatures much above 400° F. and for those containing lower amounts of copper, 300° F. is believed to be the maximum working temperature if stresses of appreciable magnitude must be considered. (29)

Materials for High Temperature Service from the Creep Design Standpoint. J. J. KANTER & L. W. SPRING. *Metals & Alloys*, Vol. 1, Dec. 1930, pages 880–882.
A general discussion. Steam power, oil refining and numerous chemical processes demands for corrosion resistance and high temperature equipment are making unprecedented requirements of the metallurgist. At elevated temperatures the real limit of elasticity is quite low and equipment cannot be designed in a practical way upon the theory of stress strain equilibrium. Creep must be accepted and dealt with at high temperatures. Corrosion and other deterioration are factors in dimensioning the load carrying members and fixing stresses. A tabulation of creep values for a variety of materials is presented. The popularity of 18–8 Metal is largely due to its corrosion resistant properties although it possesses excellent strength properties at high temperatures. The highest temperatures at which the metals will safely support 1000 lbs./in.^{2} stress with no more than 1% creep in 10,000 hours ranges from 450° F. (230° C.) for Rolled Naval Bronze to 1600° F. (870° C.) for 18–8. The steels which seem to have the highest strength and toughness at this higher temperature and above are of the highly alloyed austenitic type. There is need for data on the effect of temperature on Poisson's ratio (ratio of lateral contraction to extension). This may be determined from the combined results of tension and torsional moduli. The total amount of deformation due to creep which can be tolerated in turbine parts must not exceed 0.2% in 20 years. ESC(29)

Temperature Coefficient of the Modulus of Rigidity of Aircraft Instrument Diaphragm and Spring Materials. W. G. BROMBACHER & E. R. MELTON (Bureau of Standards). *Report* No. 358, *National Advisory Committee for Aeronautics* (1930), 16 pages, 11 references (Supt. of Documents, Washington, D. C. 10¢).

In design of aircraft instruments which must operate at temperatures between −50° and + 50° C., a knowledge of the temperature coefficient for the elastic moduli (Young's modulus and the modulus of rigidity or elasticity in shear) is necessary. Data for the modulus of rigidity and for its temperature coefficient are given for Aluminum, Duralumin, Monel, Brass, Phosphor Bronze, Nickel Brass, Coin Silver, for 1.4, 0.9 and 0.7% C carbon steels, for Cr V and Cr Mo steels with about 0.55% C, 1% Cr and 0.2% V or Mo, also for 0.8% C 13% Cr stainless steel. For most of these data were obtained in various conditions, hard-drawn, annealed, and quenched and tempered. Approximate values of the modulus of rigidity at room temperature are: Al and Duralumin 3.7 to 4, Monel 9.3 to 9.7, Brass 4.8 to 5, Phosphor Bronze and Nickel Brass 6.2, Coin Silver 4.3, the various steels aside from stainless 10.9 to 11.5, stainless 12.4; all figures in 10^6 lbs./in.^{2} Average temperature coefficients are given, but as these differ in many of the alloys, depending on whether the sample is hard drawn or annealed, and on the heat-treatment in the case of steels, and in some cases are quite different at different temperatures, the original must be consulted for them. For example, the Cr Mo steel water quenched from 870° C. and tempered at 100° C. has a temperature coefficient of the modulus of rigidity of -21×10^{-5} for the interval −15° to 0° C. and one of -45×10^{-5} for the interval +25° to +50° C., and the average coefficient for the interval −20° to + 50° C. for annealed Al is -100×10^{-5} to -135×10^{-5} while that for half-hard Al is -62×10^{-5}. The average coefficients for the various steels range from -23×10^{-5} to -48×10^{-5}, while those for the non-ferrous alloys (exclusive of Al as given above, of duralumin with -62×10^{-5} and coin silver with -56×10^{-5}) range from -34×10^{-5} to -52×10^{-5}. (29)

Properties of Steels at High Temperatures. (Les Qualité des aciers a haute température et leurs emplois à la nouvelle chafferie de la centrale d'Issy-les-Moulineaux.) C. GALATOIRE-MALEPARIE. *Génie Civil*, Vol. 95, Oct. 19, 1929, pages 373–377.

A review of recent studies of behavior of special steels at high temperatures and high pressures with special reference to equipment of the Issy-les-Moulineaux steam-electric plant. Considers special treatment of steels used and gives results of tests and operating experience and computation of the factor of safety. (29)

Carburizing and Graphitizing Reactions between Iron-Carbon Alloys, Carbon Monoxide and Carbon Dioxide. M. L. BECKER. *Foundry Trade Journal*, Vol. 42, June 12, 1930, page 439; *Iron & Coal Trades Review*, Vol. 120, May 23, 1930, page 841.

Summary from paper read at annual meeting of the Iron and Steel Institute. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. RHP + VSP(29)

The Hardness of Cast Iron in Relation to Temperature. FRANZ ROLL. *Foundry Trade Journal*, Vol. 43, July 3, 1930, page 5; *Giesserei*, Vol. 17, Sept. 5, 1930, pages 864–870.

Abstract translation of a paper read before the German Foundry Technical Association. The hardness in relation to C and temperatures was demonstrated by using space lattice obtained by researches of Robin. Time is the most important factor for the hardness of cast Fe. The hardness of cast Fe falls considerably even at 100° C. Refers also to researches of other investigators. VSP(29)

Metals and Alloys for Use at High Temperatures and Pressures. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Dec. 1930, pages 865–866.

An editorial presenting a general discussion of the demands upon metals and alloys in high temperature and high pressure application. Emphasis is placed upon the importance of refined testing methods for determination of these properties. ESC(29)

Alloys for Use at High Temperature. W. ROSENHAIN & C. H. M. JENKINS. *Iron & Coal Trades Review*, Vol. 120, May 16, 1930, pages 800–804.

Discussion May 23, 1930, page 840. Abridged from a paper before the Iron and Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. RHP(29)

Results of Endurance Load Tests on Various Construction Steels at Elevated Temperatures. (Ergebnisse von Dauerbelastungsversuchen mit verschiedenen Baustählen bei hohen Temperaturen). E. POHL, H. SCHOLZ & H. JURETZEK. *Stahl und Eisen*, Vol. 50, Sept. 18, 1930, pages 1330–1331; *Archiv für Eisenhüttenwesen*, Vol. 4, Aug. 1930, pages 105–110.

After describing an improved test method for studying the behavior of steels at elevated temperatures, the authors give results of long-time load tests which they carried on on carbon steel, nickel steel and molybdenum steel sheets of 25 mm. thickness. The load was generally increased in steps, the temperature range examined being 300° to 500° and 350° to 500° C. For the evaluation of the results of a stress-elongation diagram combined with an elongation-time diagram was chosen to clearly present the physical properties under a static endurance load at high temperatures. The endurance strength amounted for the carbon steel to 15.2 kg./mm.^{2}, at 300° C. to 8.45 kg./mm.^{2} at 400° C. and to 5.70 kg./mm.^{2} at 450° C. The values of endurance strength for the nickel steel sheet are: Above 20.0 kg./mm.^{2} at 350° C., 9.85 kg./mm.^{2} at 450° C. and 5.38 kg./mm.^{2} at 500° C. The results for the molybdenum steel are: 15.0 kg./mm.^{2} at 450° C. and 11.2 kg./mm.^{2} at 500° C. Molybdenum steel evidently shows the most favorable behavior at higher temperatures. Finally the method employed for this investigation is compared with the method by A. Pomp and A. Dahmen, *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 9 (1927) pages 33–52. (Also *Report* 98, *Material Committee of the Verein deutscher Eisenhüttenleute.*) GN(29)

REDUCTION METALLURGY (31)

Some New Developments in Aluminum Production. (Quelques progres recents dans la fabrication de l'aluminium.) *Journal du Four Electrique*, Vol. 39, July 1930, pages 259–260.

Brief sketch of Haglund, Hall, Pedersen, and Blanc processes for preparation of alumina from bauxite. The process for making Fe free Al_2O_3 by a wet method of Seailles (Echo des Mines et de la Metallurgie, Jan. 20, 1930) is being introduced in industrial use in France. Innwerk in Germany is able to produce Al with 23 kwh./kg. Arvida plant claims results better than 20 kwh./kg. JDG(31)

The Coley Process Applied to Zinc Production. *Industrial Chemist*, Vol. 6, Sept. 1930, pages 357–360.

This is a description of the process used at the Dartford (England) works of the Zinc Manufacturing Co., Ltd., for reducing calamine with nascent carbon. Cool fuel oil is lead into the presence of the hot ore (1000–1100° C.) in a large drum, where it is cracked producing the nascent carbon. The reaction is rapid; 95% of the zinc is recovered as a black powder, of which, 80–85% is finally brought into the form of ingots. The process is applicable to other ores. After the plant at Dartford had been in operation for a year, the Zinc Manufacturing company was formed, with a capital of one million pounds for the purpose of erecting a plant to produce 50,000 pounds of spelter annually. Another plant is being built at Tunis. MPB(31)

Autochrome Process. A. J. M. SHARPE. *Engineering & Mining Journal*, Vol. 128, Nov. 16, 1929, page 769.

This process produces iron and steel from chrome ore. The process parallels, somewhat, the auto-doubleage process for calorizing tubes in that either nickel chloride or cobalt chloride is mixed with the chrome ore. Tungsten molybdenum, manganese, nickel or cobalt may be similarly used. The autochrome process introduces no carbon and is cheap. WHB(31)

The Form of Copper in Converter Slag. F. S. WARTMAN & W. T. BOYER. *Metal Industry* (London), Vol. 36, May 9, 1930, pages 504–507; May 23, 1930, pages 553–556.

One of a series of reports giving results of investigation conducted by Southwest Experiment Station of the U. S. Bureau of Mines, Reprinted from U. S. Bureau of Mines. Report of Investigations No. 2985. See also *Metals & Alloys*, Vol. 1, Oct. 1930, page 790. VSP(31)

The Crumbling of Blast-Furnace Slag. FRITZ HARTMANN & ALMUTH LANGE. *Iron & Coal Trades Review*, Vol. 120, May 9, 1930, page 753.

Abstract of a paper from a recent issue of *Archiv. für Eisenhüttenwesen.* Four types of crumbling are found to be: (1) Crumbling of the lime, caused by the beta-gamma transformation of dicalcium silicate; (2) Crumbling due to iron, recognizable by soaking in water; (3) That of manganese, due to excessive manganese content; (4) Due to low strength owing to vitreous inclusions. Discusses the methods of detecting crumbling. Material is based on the authors investigations. RHP(31)

Lead Refining at the Bunker Hill Smelter of the Bunker Hill & Sullivan Mining & Concentrating Co. ALFRED F. BEASLEY (Bunker Hill & Sullivan Mining & Concentrating Co.). *Technical Publication* No. 303, *American Institute of Mining & Metallurgical Engineers*, 1930, 9 pages.

Describes in detail Parkes process in which 2 crusts or skims are taken from the desilverizing kettles. JLG(31)

An Experimental Inquiry into the Interaction of Gases and Ore in the Blast Furnace. WILLIAM A. BONE, L. REEVE & H. L. SAUNDERS. *Iron & Coal Trades Review*, Vol. 120, May 9, 1930, pages 754–758; discussion, May 16, 1930, page 795.

Abridged from a paper before the Iron & Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. RHP(31)

Continental Blast Furnace Practice. F. CLERF. *Iron & Coal Trades Review*, Vol. 120, May 23, 1930, pages 833–835.

From a paper read before the West of Scotland Iron and Steel Institute and published in the journal of the Institute. Reviews recent developments, especially German but deals with others. Discusses sources of raw materials and coke as well as the actual blast furnace and blast furnace practice. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. RHP(31)

Sintering Limonitic Iron Ores at Ironton, Minnesota. PERRY G. HARRISON (Evergreen Mining Co.). *Technical Publication* No. 284, *American Institute of Mining and Metallurgical Engineers*, 1930, 12 pages.

Ore sintered in continuous Dwight-Lloyd machines. Gives flow sheet for plant at Evergreen Mine. JLG(31)

Tin Metallurgy in Great Britain—1929. A. S. FITZPATRICK & HAROLD S. ELFORD. *Proceedings Australasian Institute of Mining & Metallurgy*, No. 78, June 30, 1930, pages 81–161.

A description of geology, treatment plants at 9 mines (with flow sheets), ore dressing machinery, roasting practice including arsenic recovery and refining of crude arsenic trioxide, magnetic separation, costs of treatment, recovery of tin oxide from mill waste, flotation in tin metallurgy, recovery of tungsten, sampling, assaying, sale of tin concentrates and smelting practice at 2 smelters. AHE(31)

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BOOK REVIEWS

Strength of Materials. By S. TIMOSHENKO. D. Van Nostrand Company, New York, 1930. Cloth, $6^1/_4 \times 9^1/_4$ inches. Part I. Elementary Theory and Problems, 368 pages. Price, $3.50. Part II. Advanced Theory and Problems. 334 pages. Price $4.50.

In the preface the author states "It is the aim of this book to present problems such that the student's attention will be focused on the practical applications of the subject." This purpose has unquestionably been achieved and the author has been very happy in his selection of illustrative problems which cannot fail to carry out his expressed intention. These problems, several hundred in number, are of 3 types; those in which a solution is completely outlined and answer recorded; those in which answers only are noted; and a considerable number in which no aid to solution is given. Regardless of his own method of teaching, each instructor will thus find ready material to suit his purpose. The figures are delightfully clear and never unduly involved.

Part I fully and carefully covers all the material needful to the general engineering student. In addition to the matter usually presented the text is extended in nearly every section to embrace numerous cases ordinarily omitted. This makes it applicable for courses where this more advanced work is desirable; yet with judicious omissions on the part of the instructor it may be adapted to the needs of more elementary courses without loss of coherence. There appear a few outstanding features worthy of note. The early introduction of deformation in frames and members, will tend to emphasize to the student this item so often ignored in texts of this kind. Stress analysis by means of Mohr's circle gives a foundation very useful in later advanced work. Particularly commendable are the discussions of non-circular and irregular sections in torsion, and the non-symmetrical sections in beams. Practically the last third of this part is devoted to the somewhat unusual material: plastic bending, combined bending and twisting and energy of steam.

Part II is obviously and admittedly for "advanced students, research engineers and designers." Beginning with complex problems in bending and passing on to curved beams, the writer continues his policy of using obviously practical examples to finished material requiring the development of special analyses. Among these may be noted the study of stresses in flywheels, perforated plates and pipe bends. After the usual development for thin plates and diaphragms the text proceeds to a study of stress in surfaces of revolution and finally to the valuable material concerning local stress in both shells, the Bellville Spring and shrink fits. The timeliness of the book is particularly illustrated by the inclusion of a chapter on stress concentrations which treats the matter from both the purely mathematical and the photo-elastic methods of analysis. Contrary to most presentations the physical properties of materials have been reserved for the last chapter of the second volume and though it is not so listed this chapter appears in the nature of an appendix.

While the opening pages of Part I give all the inherent qualities of matter needful for an analytical consideration of the subject, some instructors may feel the need of using parts of this last chapter when beginning the subject.—IRVING H. COWDREY.

Metallstock und Wirtschaftlichkeit. By RUDOLF HOFFMAN. Verlag Wilhelm Knapp, Halle, 1929. Paper, $6^1/_2 \times 9^1/_2$ inches, 104 pages. Price 9.80 RM.

The subtitle to this tract is A CONTRIBUTION TO THE QUESTION OF INTEREST CHARGES IN SMELTER WORKS, although the subject matter is really broader than this, since it contains a discussion of the general economics of smelting and refining, drawing upon lead-silver refining for illustrative details and calculations.

In the foreword the author states that the present stringent economic conditions in Germany call for special watchfulness in keeping operating capital and interest charges to a minimum. However, business everywhere seems to have learned the lesson of low inventories. Henry Ford in one of his books relates that Ford parts on freight trains en route to his assembly plants comprise a major portion of his "stock."

After dealing with the factors to be considered in appraising ores and metal stock, an extensive discussion is given of the definition of metal stock (from ores to the refined metals) and of the manner of calculating interest charges on it. In a very thorough-going treatment it is shown how the choice of the most economical smelting and refining process in any given set of circumstances may depend on the requisite metal stock and consequent interest charges for that process. A large number of detailed calculations are shown throughout the text and in tables at the end. While the information is based largely on European practice, the author shows an acquaintance with American metallurgical literature.

The author appears to be well informed on both the metallurgical and economic sides of the subject. The style is clear and stimulating. The book should appeal to executives, metallurgists and accountants in the smelting and refining industry, especially that of lead-silver.—S. EPSTEIN.

Lecons de Siderurgie professees a l'Ecole des Mines de St. Etienne. By P. ANGLES D'AURIAC. Enlarged and revised by J. Estour. Dunod, Paris, 1930. Paper, $6^1/_2 \times 10$ inches, 716 pages. Price 131.10 Fr.

There are three kinds of metallurgical books. The purely scientific do not need any comment. Those written by practical men beginning with the statement that the author is familiar with half a dozen plants and never had time for theory might be of some use to another set of even more practical men. College text-books are memorized for examinations and then forgotten as soon as possible.

Writing them down to the level of the audience instead of bringing the latter to the mental plane of the writer creates yearly a flock of young asses serenely convinced that in a blast furnace the reduction with carbon monoxide is the only reaction worth speaking about. Left to themselves and coming in contact with the actual operation of the furnaces most of them succumb to the inevitable and become deeply convinced that the application of theory to mill practice is bunk.

There is no need for giving in school a choking dose of facts and details. They will pass undigested and with only an unpleasant memory for the future. What is needed in theory is the sound representation of basic facts with the curtain lifted enough to let one peep at the immense complexity of them and the beauty of scientific logic gradually but inevitably leading to complete understanding.

The practical side of the art, protean in its very nature, cannot be covered by description of apparatus and generalities of the processes. Nor will it be wise to go into minutest analysis of some of them step by step. An insight into the phenomena underlying the major phases or peculiarities of the processes and apparatus will be immeasurably more helpful, giving to a young man a foundation on which to apply his judgment when it is matured in plant work.

One will return to the book of Professor d'Auriac long after all others are completely forgotten. The profound erudition of its author permitted him to select the very best tools for illustration of any given point. Mathematics remove mysteries from the manner in which particles of the burden are or ought to be distributed in a stack for the best results. Physical chemistry takes care of the equilibria occuring during processes. When some disputable matter comes to light such as the optimum lines for a blast furnace it is not left to guess or speculation, but the author goes directly to the result already obtained along similar lines. He is equally familiar with, say, Rachette's oval furnace in the Urals of the sixties or No. 1 Aliquippa stack blown in in 1927. In questions of vital practical import his experience and acquaintance with the plants of the world leads to unmatched treatment of the subject as is the case, for example, of desulphurization in the mixer. He helps himself with equal ease to the data obtained by Matsubara or McKinney with his associates or to conclusions reached by Neilson of the hot blast fame during the latter's experiments on dry blast more than a century ago. There is no piling of facts, ideas or statistics for the sake of record only. Everything written has a definite aim either to remove some objections to a conception, to explain the mechanism of some reaction, to point out the characteristics of an apparatus, its peculiarities and behavior or to lead the metallurgist to clear understanding of what might happen after certain changes in equipment or practice. Not a single question of any magnitude is omitted.

The hastiness of the publishers seems to be the major defect of the book. At the time of his death Professor d'Auriac had the book which contained the very latest ideas of the contemporary practice and thought. A worthy pupil of the master, Mr. Estour, followed the ideas of his preceptor when enlarging and bringing to date his work and did it so that no difference between the original and enlarged work can be perceived either in spirit or in comprehensiveness with the exception that the latter contains all new developments of the past years with literary references reaching papers published in 1930 and world statistics brought up to 1927. The thoroughness of the work requiring very considerable time, prevented Mr. Estour from covering the whole ground in the time given to him. From four major divisions of the book, preparation of metallurgical fuel, blast furnaces, Bessemer process and open hearths, two first received the full benefit of the reviewing while the last two on many occasions are a score of years behind the times. Were the whole book brought to the excellency of its first half it could be unconditionally recommended to all metallurgists. As it stands now any reader wishing to refresh and enlarge his knowledge of coking practice or blast furnaces cannot do anything better than to read the combined efforts of the authors. An open hearth man or a Bessemer blower will, however, find but little which will directly bear on the present-day practice.—JOHN D. GAT.

Wärmewertigkeit, Wärme- und Gasfluss, die physikalischen Grundlagen metallurgischer Verfahren. By HUGO BANSEN. Verlag Stahleisen, Düsseldorf, 1930. Cloth, $8^1/_2 \times 11$ inches, 61 pages. Price 10 RM.

This work outlines a treatment of the thermal efficiency of high temperature processes distinctly superior to the common type of heat balance. Thermal data are assembled in diagrams which show side by side the quantity of heat required and the amount available together with the temperatures at which these quantities are demanded and supplied. The details of these rather intricate diagrams are treated at length in auxiliary sections at the end of the book. They present very effectively the increase in temperature possible by the utilization of waste heat in preheaters. Numerous thermochemical equations and tabulated data are also given.

The combination of operating data with thermochemical calculations is illustrated chiefly in a thorough exposition of the thermal efficiency of the iron blast furnace. Other processes discussed include the operation of the open-hearth furnace and the basic converter, sponge iron manufacture and the utilization of various fuels.

The importance of time in a quantitative study of metallurgical heat requirements is also emphasized. This is illustrated by studies of the heat transfer in regenerators and recuperators, blast-furnace stacks, and Dwight Lloyd sintering machines. The flow of gases through layers of solids is discussed in connection with the last two illustrations. Time studies are shown to be useful in choosing the size of unit most efficient for producing given tonnages.

The table of contents includes lists of tables and diagrams as well as a complete list of subject headings but there is no alphabetical index. The sources of the thermochemical data are not stated, though numerous references to earlier work on heat balances are cited. Misprints are not infrequent in the explanatory sections.

The study of thermal processes without resort to formal thermodynamics is effective, and the diagrammatic representation is especially welcome to the American reader.—G. L. FREAR.

Die Gussröhren Herstellung in der fester Form und Schleuderform. BY H. WEBER & H. HERMANNS. Heft 3, 1927. Paper, $6^1/_2 \times 9$ inches, 68 pages. Price 4.50 RM.

Herstellung der Abgüsse in der Graugiesserei. BY E. BAUER. Heft 11, 1930. Paper, $6^1/_2 \times 9$ inches, 72 pages. Price 6.20 RM.

Die Maschinenformerei und Kernmacherei in der Eisengiesserei. BY E. BAUER. Heft 12, 1930. Paper, $6^1/_2 \times 9$ inches, 72 pages. Price 4.80 RM.

Parts of H. Hermanns' series—Die Betriebspraxis der Eisen, Stahl und Metallgiesserei. Published by W. Knapp. Halle, Germany.

These are elementary treatises in a series on foundry practice. In the one on cast iron pipe, Weber describes ordinary molding practice. The machine molding and sand handling equipment of a large German plant is described. In the second part of this, Hermanns describes the various processes for centrifugal casting of pipe, the difficulties encountered and discusses the structure and physical properties of the product.

Bauer deals with the making of gray iron castings, touches on the mixing of irons, quite thoroughly discusses gating, chills and risers, and deals exhaustively and interestingly with casting stresses and their avoidance. Sketches show why cracking or warping occurs, and how the design of the part may be made so as to avoid these troubles.

In the one on machine molding and core making Bauer describes matchplates, strippers and squeezers, jar-rammers and sand slingers, various systems of mold transportation, and core-making machines of various types. The illustrations give a good idea of German practice.

All the booklets are well indexed.—H. W. GILLETT.

Techno-Diktionär. By HUBERT HERMANNS. Published by the author, Berlin, 1929. Paper, $4^1/_4 \times 6$ inches, 432 pages. Price $2.75.

This is a three-way technical dictionary, containing English, German and Italian terms, and will be a convenient auxiliary to the more general book. It gives no information save a bare translation of the term involved.—M. L. MOORMAN.

Ingot Contour and Its Relation to Sound Steel. Gathmann Engineering Company, Baltimore, 1930. Half cloth, 6×9 inches, 90 pages. Price $1.00.

The seven major stages in steel production from the molten to the bloom are listed. Classes of steel are next discussed: fully-deoxidized, semi-deoxidized and rimming steel and the effect of molds are considered. Other subjects: solidification, inspection, ingot taper, effects of mold design on solidification, essentials to soundness, ingot surface, segregation are covered. R. R.

The Mineral Industry, Its Statistics, Technology and Trade during 1929, Volume XXXVIII. Edited by G. A. ROUSH. McGraw-Hill Book Co., Inc., New York, 1930. Cloth, $6^7/_8 \times 9^3/_8$ inches, 845 pages. Price $12.00.

The latest volume of this exact and complete guide-book of the mineral industries is now available. The contributors should be congratulated on the conciseness and value of their various sections; the editor has continued his laudable idea of obtaining contributors who are authorities in the various fields.

Additions include lists of Trade and Professional Organizations and Diamite Statistics. Changes occur in the combining of Beryllium, Bismuth, Cadmium, Selenium, etc., under the heading of Minor Metals, and Bromine, Feldspar, Fuller's Earth, etc., under Minor Nonmetals.

The book itself is 43 pages larger than last year's edition.—W. B. DILLINGHAM.

Symposium on Aircraft Materials. Published by American Society for Testing Materials, Philadelphia, 1930. Cloth, 6×9 inches, 189 pages. Price $2.00.

The seventeen papers and discussions presented at the Aircraft Symposium held at the 1930 A.S.T.M. meeting (which have previously been abstracted in the Abstract Section), are now available in bound form. This was a valuable symposium dealing with alloy steels and light alloys, heat-treatment, welding, metal joints, specifications, materials control, etc.—H. W. G.

Aluminum in Aircraft. Aluminum Company of America, Pittsburgh, 1930. Paper, 159 pages. Price 50 cents.

This is one of the useful and authoritative handbooks of the Aluminum Company of America which contains much technical information.

The approximate composition, methods of heat-treatment, physical constants, mechanical properties and corrosion-resistance of the wide range of aluminum alloys applicable to aircraft construction are given in detail. Short-time high-temperature tensile properties are included.

Crank cases, pistons, propellers, spars, beams and girders, fuel tanks, wing and fuselage coverings, etc., etc., are discussed as to materials and fabrication. Welding, riveting, and anodic treatment as a preparation for protective coatings are thoroughly discussed, and much data given on corrosion prevention and the inspection of parts subject to corrosive conditions. The available commercial shapes are listed.

While the advantages of metal construction are stressed, the book is not primarily propaganda; it is a compendium of technical information, and states the drawbacks and limitations of the aluminum alloys as well as the good points. It is written from a sound engineering point of view.—H. W. G.

A.S.T.M. Standards. Issued Triennially. Pt. I. Metals, 1000 pages. Pt. II. Non-Metals, 1214 pages. Published by American Society for Testing Materials, Philadelphia, 1930. Price each volume $7.50; half leather $9.00; both parts $14.00; half leather $17.00.

The A.S.T.M. standards form an important compendium not only of accepted standards, but also of methods of testing, and, to a lesser degree, of recommended manufacturing practice.

In the volume relating to metals are 76 standards dealing with steel, 9 with wrought iron, 11 with pig or cast iron, 8 with ferro alloys; a total of 104 in the ferrous field, while there are 66 on non-ferrous metals and alloys. Approved methods for chemical analysis are given for the determination of most of the constituents of the alloys dealt with.

Very definite modes of procedure have been adopted for tensile, compression, magnetic and Brinell hardness testing, and recommended practices are advanced for metallographic examination, thermal analysis and radiography.

It is interesting to note that radiography, a new-comer, has been brought to a point where acceptable methods can be stated, while test methods for determination of impact resistance, endurance under repeated stress, resistance to corrosion and to wear, or for the determination of properties at high-temperatures, remain un-defined.

Of course, most of these subjects are under discussion and study by the Society, with symposia or at least frequent articles devoted to them, and several of the items are being actively studied by research committees. However, the study of only a few of the causes for deterioration and failure of metals has advanced to such a point that we really know how to measure the properties concerned.

That accelerated methods of corrosion-testing of metals are not considered reliable is well indicated by the absence of any such methods from the list of standard tests, and the fact that many of the research committees have sponsored extensive exposure tests for evaluating corrosion tendencies.

The only test relating to corrosion is one to show the presence of active sulphur or sulphur compounds in gasoline, by the use of metallic copper.

The standards of the A.S.T.M. have been filtered through the minds and experience of many representatives of producer, consumer and "general interests," and in many cases are based on exhaustive research. There is a growing tendency to determine the fundamental engineering facts required for the formulation of a sound specification by means of research rather than by snap judgment.

The volumes are indispensable to producers and consumers of the commodities dealt with.—H. W. G.

La Soudure Electrique a l'Arc. BY R. SARAZIN. Journal de l'Industrie et de la metallurgie francaises, Paris, 1930. Paper, $6 \times 9^1/_4$ inches, 348 pages. Price 38.50 francs.

For American practice, this book is of little value since much antiquated information, at least for Americans, is contained in it despite the recent publication of the book. Some of the illustrations, for example those on pages 48, 89 and 98 in the first part, might well have been omitted; and, to the American welder, it is a strange spectacle to see a man holding the mask before his face with his hand instead of having it fastened to his head, leaving him with the free use of both hands.

In contrast, the second part on the apprenticeship of the welder is made valuable by the detailed instructions it contains. The chapters on composition and building up of shapes from structural material and the carrying out of repairs, with illustrations of some difficult cases, are also instructive. A special chapter is devoted to the electric welding of non-ferrous metals.

For those who read French, the book is quite instructive, especially in fundamentals, if one is able to disregard out-of-date information.—M. HARTENHEIM.

Metaux et Alliages. BY C. GRARD & J. COURNOT. Berger-Levrault, Paris, 1930. Three volumes, paper, $6^1/_2 \times 10$ inches. Vol I, 321 pages, Vol. II, 295 pages, Vol. III, 317 pages. Price 3 volumes 110 Fr. Each Volume 40 Fr.

In three volumes of *Metaux et Alliages* the authors placed before themselves the problem of presenting the whole enormous building of metallurgical knowledge from ore dressing to protective coatings. A stupendous problem and exceedingly difficult to accomplish considering the size of the work, only 933 pages of large type. General Grard and Dr. Cournot solved it in an original way. Offering their thoughts along the usually accepted program—the theory and testing in the first volume, ferrous metallurgy in the second and non-ferrous material in the third, they removed from the stage so much detail that with the exception of some subjects the series appear as a skeleton of the science.

The promise made in the preface of bringing to light the very latest developments is fulfilled in some cases, such as testing and examination of materials, heat treating of many alloys and means for protection of metals from corrosion. At the same time several innovations of the past few years are not even mentioned. Among these are application of high frequency electric furnace to steel making, introduction of tungsten carbide, hardening of copper by precipitation, etc. Other points are passed sometimes with only a brief mention. X-rays are dismissed in five lines. Brasses, including their preparation, are treated on nine pages. The description of ghost lines as streaks of non-metallic inclusions, unquestioned acceptance of beta iron or attribution of soft spots on abnormal steels to low carbon content must be termed at least original.

The publishers of the set made of it an irreproachable job, one of the best metallurgical treatises coming from France in a long time. However some misprints occur in the most inconvenient places as when all standard specifications for aviation steels call for 0.04% phosphorus, *minimum*. The use of photomicrographs is rather peculiar. High points of ferrous metallurgy are sufficiently illustrated but the non-ferrous field is not even touched with the exception of six excellent color photographs of aluminum alloys.

We do not live in an age when a Newton could tell everything which was known. A substantial acquaintance with a single speciality now demands more than a lifetime of a capable man. A really good book is placed here in an equivocal position by the lack of some appropriate adjective in the title limiting its scope to testing, heat treating and protection of metals. Both authors have these subjects at their finger tips and know how to convey the information to others. The presentation of these subjects is well thought over, clear and complete. Giving a very large amount of material applicable to any conditions it brings the French viewpoint on many vital points of testing and protection, indicates some new methods of approach and describes much equipment not familiar in the states. The rest of the book is elementary, though remarkably well written.—J. D. GAT.

Materials of Engineering Construction. BY FRANCIS W. ROYS. Ronald Press, New York, 1930. Cloth, $6 \times 8^1/_2$ inches, 331 pages, 167 figs. Price $4.00.

The book is intended as a text for engineering students, to familiarize them with their materials, and is well planned for this purpose. The execution of the details, however, is frequently poor—particularly in those parts dealing with metals. In these days of intense specialization it is unfair to expect an engineer to write a treatise on metallurgy to meet the approval of metallurgists, but the value of the book would have been greatly enhanced had the author been assisted in all parts by specialists in the various metals discussed, as he was in writing the sections dealing with malleable cast iron, wrought iron, and to some extent the part on aluminum and its alloys. For other metals the author himself endeavored to select his material from the mass of literature and made some unfortunate choices.

It is, perhaps, the mere fact of the reviewer's own specialization which makes him criticize most severely the section dealing with copper and its alloys, but any metallurgist would be unfavorably impressed if he saw a peritectic reaction in the most important non-ferrous equilibrium diagram shown as a sloping curve! The copper-zinc diagram, which shows the old beta eutectoid now known to be a polymorphic change, is not even correctly reproduced from the source given. The statement that alloys of copper with 35–45 percent zinc may "even contain fine delta under peculiar conditions" prepares one for the statement that a 60–40 brass, if annealed and quickly cooled from 600° C. becomes homogeneous beta, which will withstand considerable cold rolling. This is supported by an excellent photomicrograph showing the normal structure of twinned alpha and beta with the caption stating it to be nearly homogeneous beta solid solution.

The section on the manufacture of steel probably has enough detail for the engineer, and the principles of heat treatment are fairly well explained on the basis of the diagram. The engineer is given no information as to practical methods of heat treatment, neither is he given complete sets of figures showing the variation of properties with heat treatment.

The theory of corrosion is well presented, mainly on the basis of Evans' work, but no mention is made of selection of alloys for use under various corrosive conditions, which is of great importance to the engineer.

The statements that steel is nitrided at 500° F. and that lead is nearly four times as heavy as iron may, perhaps, be the printer's errors, as also undoubtedly are "0.085%" and "85 to 150%" carbon given as the composition of eutectoid and tool steel respectively on page 223, "magnesia" for magnesium on page 231, "kisle" for kish on page 144 and "dioxidize" for deoxidize on page 246.

The book is nicely bound, well printed on good paper and the many illustrations are excellently reproduced. The index is one of the best and most complete that the reviewer has seen, and it is to be regretted that the material is hardly worthy of it.—CYRIL STANLEY SMITH.

Lehrbuch der Metallhüttenkunde. By VICTOR TAFEL. Verlag S. Hirzel, Leipzig, 1927. Cloth, 7 × 10 inches, 426 pages. Price 27 RM.

The author has collected his information from widely scattered sources such as books, transactions of different societies and periodical technical papers which have been published during the last few years. It would be unjust to say, however, that the result is simply the quoting of other men's words.

Dr. Tafel had years of personal experience in the mining field before he accepted his present position as Professor of Mining and Metallurgy in the University in Breslau. His experience as a scientist and a practical engineer is easily discerned in his book. This book is intended first as a text-book for German students to instruct them in the latest foreign literature, especially American, on the subject of metallurgy. He is also anxious to have the practical end in mind when comparing different methods and in this way he gets away from the usual text-book which the student often finds dry. This method of instruction is something very new in Germany and still in the experimental stage. The result they wish to accomplish is to bring out of German universities men who are not only filled with theories but at the same time know the practical side which is necessary to survive to-day in modern technical life.

The first volume handles in four chapters the metals, gold, silver, platinum and copper. Each chapter starts with the history of the metals, their distribution on the globe, the characteristics of the elements, their alloying properties and the different methods of producing and refining. Every chapter closes with cataloging literature on the subject. In the appendix practical mathematical examples are given to make the student familiar with some of the calculations in the metallurgical industry.

Of interest would be a bibliography of the most important patents covering the field.—F. TOBIAS.

The Elements of Ferrous Metallurgy. By JOSEPH L. ROSENHOLTZ. John Wiley & Sons, Inc., New York, 1930. Cloth, 6 × 9 inches, 248 pages. Price $3.00.

As stated in the preface this elementary text-book of ferrous metallurgy is intended as an introduction to the subject for students in technical high schools and colleges. As such it is good although we incline to the belief that for college students a more comprehensive treatment is advisable. An idea of the field covered is obtained from the chapter headings: Fundamentals, The Blast Furnace, Wrought Iron, The Cementation and Crucible Processes, The Bessemer Process, The Open-Hearth Process, The Electric Process, Defects in Ingots, The Foundry, The Iron-Carbon System, The Mechanical Treatment of Steel, The Heat Treatment of Carbon Steels, The Constitution of Carbon Steels, The Simple Steel Analysis, Alloy Steels, Cast Irons, Malleable Cast Iron. Considerable information is given.

A book of this character should give the student an idea of the relative economic importance of the various methods of steel making and steel products. This is not done. As much space is given to products of low tonnage as of high tonnage.—V. V. KENDALL.

Allgemeine Physik der Röntgenstrahlen. Handbuch der Experimental Physik. Vol. 24, Part 1. By F. KIRCHNER. Akademische Verlagsgesellschaft m. b. H., Leipzig, 1930. Cloth, 7 × 10 inches, 550 pages. Price 55 RM.

This new volume in the remarkably complete series of handbooks on experimental physics is unquestionably the most monumental work covering the general physics of X-rays which has ever been written. It is as nearly a complete account of all of the experimental facts dealing with X-radiation as such, as can possibly be imagined. The topics considered in order, after the general introduction covering the excitation of X-rays and their general properties, are: X-ray tubes, high tension equipment, the current-voltage characteristics of X-ray tubes, the intensity of rays emitted from X-ray tubes, electron emission by X-rays and the accompanying phenomena including the photoelectric emission, scattered electron emission, characteristic X-rays and characteristic electron emission, the secondary effects of X-rays upon matter through the action of photo and scattered electrons, the nature of scattering, the intensity of scattered rays, the theory of scattering of X-rays, wave length determination from diffraction and interference.

This great work can be thoroughly recommended to any reader who desires an exhaustive account of the experimental facts. One unusually excellent feature is the completeness with which the literature other than German is covered so that in no sense can a one-sided or prejudiced point of view be claimed.

Dr. Kirchner is one of the expert pioneers in X-ray science and his treatment is thoroughly authoritative. Some of the topics are somewhat difficult to find and on account of the nature of the presentation the treatment of a given topic is separated in various parts of the book, such as the Compton effect which is treated in 3 different places. However, these are points of minor importance when the nature of the book is considered. It is designed for a purely scientific group of expert readers. The mechanical features of the book are all that can be desired and although the price is fairly high, it is not by any means exorbitant for this treatise.—G. L. CLARK.

Iron and Steel Industry Handbook and Directory. Louis Cassier Co., Ltd., London, 1930. Paper, 6 × 9 inches, 234 pages. Price 10 sh.

This handbook covers the following subjects: Ores, fuels and refractories; blast furnace practice; foundry practice; wrought iron; steel-making practice; heat treatment and physical testing of iron and steel.

The following directories are also included in this volume: Iron & Steel Trades Associations and Societies, Scientific and Technical Institutions, Iron and Steel Foundries in Great Britain, and Blast Furnaces and Steelworks.—R. R.

Metal Industry Handbook and Directory. Louis Cassier Co., Ltd., London, 1930. Paper, 6 × 9 inches, 400 pages. (Not sold, given to subscribers to *Metal Industry*, London.)

This handbook is published annually by *Metal Industry* (London). In this edition the section "Properties of the Principal Metals," has been rewritten as regards aluminum and chromium, and mercury has been added. A similar revision was made in the section, "Properties of Some of the Rarer Metals," for molybdenum, thallium, titanium, tungsten, uranium, vanadium and zirconium, while cobalt has been included.

A table dealing with the fusing currents in amperes, for wires of copper, aluminum, tin and lead has been added. A number of new British Engineering Standards Association specifications have been added, and the section "Non-Ferrous Materials Specifications for Aircraft Parts" has been completely revised. A new section dealing with protective coatings other than electroplated ones is included.—R. R.

Metallurgie Agenda Dunod 1931. Dunod, Paris, 1931. Cloth, 4 × 6 inches, 497 pages. Price 23.50 Fr.

This pocket-size metallurgical handbook starts with a 1931 calendar with a patron saint for each day, and ends with 70 pages of the French laws on labor contracts, employment of women and children, etc., 30 pages of lists of books sold by Dunod, and a few blank pages of cross section paper.

In between are some 350 pages of descriptive, statistical and tabular matter of the sort usual in handbooks of this kind. A good deal of the data is not very well up to date. Some of it is interesting as showing the French point of view, but as a handbook, it is not very useful to the American metallurgist.—H. W. GILLETT.

Engineering Metallurgy. BY B. STOUGHTON & A. BUTTS. McGraw-Hill Book Co., second edition, 1930. Cloth, $6^1/_2 \times 9^1/_2$ inches, 498 pages. Price $4.00.

The second edition is enlarged by about 60 pages over the 1926 edition. The increase deals largely with welding, with additional data on alloy steels, and with a more complete treatment of physical metallurgy, especially in regard to heat-treatment. There has been considerable rearrangement of the subject matter on the basis of experience in its use as a college text.

The book has been brought up to date in several ways, partly by inclusion of new matter, and bringing statistics up to date, but especially by rephrasing or omission of various inaccurate or doubtful statements which marred the first edition.

As an example of the improvement in this regard, what amounted to an endorsement of various "accelerated" methods of endurance testing, has been eliminated. There are still a good many rather dogmatic statements that would require considerable elaboration to give the student a really true perspective. For instance, it is stated that sulphur in steel is harmful "in any form or in any amount over 0.01%."

The brevity of statement may sometimes lead the student astray. He will probably get the idea from the brief comment on nitriding that the process is regularly applied to plain carbon steels as an alternative to carburizing. And in such cases the references are scarcely complete enough to guide him to more specific information.

There is brief mention of cemented tungsten carbide, the Sperry detectoscope and the stethoscopic testing of welds. But the Aston process is not discussed, though the old puddling process gets brief mention.

From such mention of die casting as is made, the student will be led to place aluminum alloys in a rather more important position in comparison to zinc-base alloys than they really possess. The inclusion of a figure showing the granular resistor type of electric brass melting furnace would lead the reader to suppose that that type was still important commercially. One would gather that welding was a more important metallurgical process than the hot and cold rolling of steel, from the relative space devoted to them, and he would not grasp the fact that deep drawing of steel and the making of steel suited to deep drawing are as important as they are. The importance of the austenitic stainless steels is not adequately brought out, even for readers who are beginners.

But whether the reader agrees with the authors in the relative stress placed on different topics or not, he must admit that a vast amount of useful metallurgical information, including at least a smattering of most subjects anyone would want included in a general metallurgical course, has been packed together in the book. The scope of the subject matter is so well known to the many readers of the first edition that it is only necessary to say that the second edition is a real improvement and that the price is reasonable.—H. W. GILLETT.

Electroplating. BY SAMUEL FIELD & A. DUDLEY WEILL. Isaac Pitman & Sons, New York, 1930. Cloth, 5 × $7^1/_2$ inches, 205 pages. Price $2.00.

Field is head of the Chemistry Department, Northampton Polytechnic Institute, London, Weill is Technical Director of a London firm selling electroplating supplies. The illustrations are chiefly woodcuts of apparatus sold by this firm.

The discussion of the chemistry of electroplating is very elementary, but clear. Instead of giving a great variety of formulae for plating baths for the deposition of a given metal, one or two that have been found satisfactory are given, every opportunity being taken to urge the use of a simple solution.

A sane point of view is taken throughout. It is stated that while cadmium plating has attained extensive use, its value has to be established. Deposition of cadmium-silver alloys is classed as an unsolved problem.

The book is obviously written primarily for the small job plater. Automatic plating methods and large-scale methods in general are scarcely mentioned. Within its scope it is a useful little book.—H. W. GILLETT.

Jahresbericht der Abteilung für Metallchemie und Metallschutz. Reprint from Jahresbericht VIII. Verlag Chemie, Berlin, 1930. Paper, 6 × $9^1/_4$ inches, 54 pages. Price 6.40 RM.

In the study of corrosion theories, the Reichsanstalt has dealt with electrochemical methods and with Evans' aeration principle. An investigation on the corrosion of aluminum by hydrogen peroxide, to simulate an oxidizing attack, and on the inhibiting effect of sodium silicate, was carried on. Study was made of pairs of metals in contact, wholly immersed and of pairs each metal of which was partly immersed in sea water in separate beakers, but the solutions were connected by a tube and the metals by a wire. The potential between the metals is read from time to time. This work is in progress, and results will be reported later.

A table of potential measurements on various rust-resisting steels in various H_2SO_4-$CuSO_4$ solutions is given, which is claimed to class the steels more or less in the order of their rust-resistance. Current-time curves obtained from a cell made up of the steel under test against Cu in distilled water under an oxygen pressure of 120 mm. of water showed a knee in the curve when rusting starts. With the 18-8 type of steel, in properly rust-resistant condition, the initial current promptly falls to zero.

Work on paints for corrosion protection is reported, and brief comments made on various routine tests that were carried out in the laboratories on failed materials brought in for examination.—H. W. GILLETT.

Toward Civilization. By CHARLES E. BEARD. Longmans, Green & Co., New York, 1930. Cloth, 6 × 9 inches, 307 pages. Price $3.00.

Answering the challenge of a former symposium, "Whither Mankind," this volume presents the opinions of sixteen scientists and engineers constituting a survey of the technical tendencies of our modern age and a defense of machine civilization. The introduction and summary are by the editor. The essays are interesting in that they are written by such well-known persons as Robert A. Millikan, Lee deForest, Elmer A. Sperry and Lillian M. Gilbreth.—M. L. MOORMAN.

Die Strichprobe der Edelmetalle. By Karl Hradecky. Julius Springer, Vienna, 1930. Paper 6 × 9 inches, 83 pages. Price 7.5 RM.

This little volume is a treatise on the proximate analysis or assay of noble metals and their alloys by means of the "streak test," using the methods of mineralogy and microchemistry. There is first a discussion of the "streak" of alloys, the accuracy of this method, the determination of fineness, and the materials used in making the tests.

Then follows the testing of silver and gold alloys, including white golds. Platinum, palladium, and their alloys are also discussed.

Distinguishing genuine from imitation alloys occupies two pages.

Pages 67 to 81 present a systematic scheme for the examination of unknown noble metal alloys. The tables remind one of the outlines used in qualitative chemistry, mineralogy, etc.

Besides the methods of identifying and evaluating the various noble metals and their alloys, the author has given some information regarding the more recent uses of these alloys and their compositions.

This book will be of most use to dealers in secondary metals, but it should also be of value to analysts and assayers.—O. E. Harder.

Oxy-Acetylene Welding and Cutting. By Stuart Plumley. University Printing Company, Minneapolis, 1930. Cloth, 8 × 11 inches, 302 pages. Price $7.50.

Ability to write in a style that can be readily understood by the practical man and not be boring to the technical man or engineer, together with a thorough understanding of the subject is indeed a rare combination but we have it in this book. The author has been intimately associated with the oxy-acetylene industry for somewhat over twenty years, has learned much and has now put his knowledge in such shape that it may be readily assimilated by others without much effort.

The subject "Oxy-Acetylene Welding and Cutting" is treated much the same as a course in physics. The book being divided into twenty lessons corresponding to chapters and each lesson is followed by a job sheet equivalent to the physics experiment. At the end of each lesson there are also a number of questions which serve as a review. The book is a combination of text and manual, but may be read with profit by those interested in the art of oxy-acetylene welding and cutting but who do not have the facilities for performing the experiments given on the job sheets.

The first four lessons devoted to gases, details of construction, and use of torches, regulators, generators, etc., lays the foundation which will be found invaluable in a study of the subsequent chapters. This part of the book may be open to the criticism that the description and illustrations cover only one make of equipment but there is usually sufficient similarity between this equipment and the equipment of other manufacturers to permit applying the knowledge gained in the reading of these lessons to the apparatus of other manufacturers.

After covering in detail the proper setting up and use of the apparatus with due regard to the various elements of hazard the following lessons carry the reader through various methods of welding, brazing, and cutting of ferrous materials of a variety of shapes and sizes.

Recently the welding of pipe has been receiving much attention and the author very properly devotes two chapters to this important development. The first dealing with the smaller sizes of pipe, and use of templates, such as are used for steam and hot water heating, and the second applies to the larger sizes of pipes of which thousands of miles have been welded for the conveying of natural gas, oil, etc., from the oil fields to the larger centers of population.

The author has not confined himself to the oxy-acetylene welding of the ferrous metals but gives nearly as much space to the latest and approved methods of brazing steel and cast iron and the welding of a number of non-ferrous metals including aluminum, nickel, monel, copper, etc. and one lesson is given over to lead burning and soldering of automobile radiators.

As most welders are poor business men the author has sought to improve this condition by a lesson: "The Business Side of Welding" which contains instructions for the proper determination of costs and typical job cards and ledger sheets for recording pertinent facts in reference to work performed, materials used, etc.

The book ends with a short lesson on "Airplane Welding" and a job sheet covering the welding of tubing but a review would not be complete without calling special attention to an outstanding feature that is, the excellency of the numerous (over 400) line cuts and illustrations which aid greatly to a clearer understanding of the test.—J. J. Crowe.

High Speed Steel. By M. A. Grossman & E. C. Bain. John Wiley & Sons, New York, 1931. Cloth, 6 × 9 inches, 173 pages. Price $3.50.

Things generally appear complex only when we do not understand them. Grossman and Bain have taken much of the mystery out of high speed steel. By the assumptions that 1% of Cr is equivalent to 0.5% W, of V to 4.0% W, and of Mo to 1.3% W, that the carbide in high speed steel is Fe_4W_2C with some of the W substituted by the other elements, and that Co and the balance of the Cr goes into the ferrite, they set up a pseudo-binary ferrite–carbide system whose schematic diagram is entirely analogous to the Fe–C system. From the equivalent carbide content the behavior of high speed steel can, by means of this diagram, be explanied and remembered.

All through the book the behavior of high speed steel is described, and a very satisfying reason why given for every action. Ferrite, carbide and retained austenite, with hardening and tempering phenomena modified by the sluggishness due to the alloying elements in the ferrite and austenite, are brought to mind all through the book. The analogy with ordinary steel is so skillfully drawn and the differences so logically explained that the book is extremely easy to read.

The first half of the book, dealing with manufacture, is as satisfying as that dealing with composition and structure. Each step in melting and working is explained with clear comment on its bearing on the quality of the finished product. The book everywhere bears the earmarks of being written by those who know what they are talking about. Much data by other workers is incorporated to prove and clarify various points, but one gets the impression that the authors appreciate the bearing of such investigations on the general subject just as well as those who did the work.

Hence we have a book that fits all the pieces of the jig-saw puzzle together into a clear picture, rather than a kaleidoscope of jumbled facts and second-hand opinions such as we find in so many text-books and handbooks on technical subjects.

The authoritativeness with which the book is written, the clarity of understanding of the problem and the clarity of expression of the facts and principles makes it class very high. It is not only an extremely informative book, but it is a fine specimen of technical writing.—H. W. Gillett.

Der Temperguss. By Schüz-Stotz. Julius Springer Verlag, Berlin, 1930. Cloth, $6^1/_4 \times 9^1/_2$ inches, 390 pages. Price 39 RM.

This volume by two German metallurgists who have been active in the field of malleable iron, constitutes a welcome addition to the literature; first because it brings up-to-date in summarized form the available knowledge of the properties of malleable iron and second, because it presents the subject from a European viewpoint.

The subject matter is arranged in what may be considered an entirely orthodox form beginning with a history of the product which in turn is followed by a discussion of the scientific principles involved in its manufacture; following this a larger portion of the book is occupied by a discussion of the technology of malleable cast iron beginning with melting stock and ending with finishing operations. There is then a chapter dealing with various physical properties of the material and finally one covering production costs.

The entire group of subjects is authoritatively discussed, frequently by reference to other writers and so far as either necessary or desirable in a book of somewhat under four hundred pages, exhaustively treated

An American review of a German text must of necessity recognize certain differences of viewpoint which are fundamental where the author and reader are of different nationalities. The industrial conditions of two nations are never so nearly alike as to make it possible to write a text equally suitable for two or more countries. Since scientific principles and physical properties are independent of these variables the sections dealing with these subjects will very probably be of major interest to American students.

Since the authors deal in their volume with both black heart and white heart malleable, they have very naturally given space under both these headings to subject matter not usually found in the technical literature of the United States; thus they discuss at considerable length the processes of decarburization mainly in the light of Schenck's work on the iron-carbon-oxygen equilibria. The American reader may find this discussion of considerable value even though his own interests lie in suppressing decarburization rather than in favoring it.

In their discussion of graphitization the authors lay somewhat more stress on the principles of crystal growth than is commonly done in this country. This viewpoint is one to which we may well give consideration in this country to a greater extent than heretofore.

In the large section on technology the authors have sought to describe substantially all the methods and equipment used in German malleable plants, this has caused the inclusion of descriptions of processes which are either obsolete in the United States or otherwise impracticable. Thus the manufacture of crucible or convertor malleable is outside the interest of American readers and the space given to cupola malleable is disproportionately large from this country's viewpoint. For those who are operating this method in the United States, however, the book holds more information than has, to the writer's knoweldge, been elsewhere assembled on the subject of this particular method of production.

One subdivision of the section on technology may prove of very great interest in the United States; this is the author's treatment of the Brackelsberg furnace concerning which there is as yet no American experience in published form but which may be destined to fill a considerable field in this country.

The descriptions of foundry equipment include both European and American machinery and will be of relatively little importance to foundrymen in this country; they will find themselves already familiar with the equipment which originates in their own country and probably not very greatly interested in the European apparatus.

The chapter on production costs although bearing no relation to the corresponding costs in this country, is an illuminative comment on the economic systems of two important manufacturing nations.

As already stated the authors intend to cover both the black heart and white heart industry. As a matter of fact they apparently distinguish three kinds of malleable iron, "white fracture" which we call white heart; "black fracture" which we call black heart and an intermediate variety which they call black heart and which to us is "picture framed" iron. Since they do not carry this terminology throughout their entire discussion, it is not clear whether or not they recognize the latter classification as a mere defect of the black heart process. The authors are altogether cognizant of the difference in practice between the white heart and black heart industries using these words as understood by Americans and strive to emphasize this difference; there are, however, portions of the book where we who unconsciously think of all malleable iron as black heart, are likely to go astray unless we keep constantly before us the fact that the authors are speaking of both materials and we must be constantly on our guard to be sure from the context which one is referred to at any given point. The reviewer has found this difficulty particularly great in reading the discussion of the effect of silicon on the physical properties of the product.

Since there is no American literature of the white heart process, the present volume furnishes about the only complete and condensed source of information on that industry for those who may be interested therein.

The literary style is unusually concise and lucid as compared with most German works and the book is to be highly recommended to American readers possessing a working knowledge of that language. It will probably be most useful to those interested in general metallurgy or in the technical fundamentals of the manufacture of malleable castings. Those interested in cupola malleable or the Brackelsberg furnace will find much of importance to them while the reader of the strictly "practical" type whose interest is solely in manufacturing details will perhaps fail to benefit very greatly from its study.

One feature of a strictly practical nature should prove equally useful in all countries; this is the authors' discussion of the design of castings from the viewpoint of their economical and satisfactory production. The principles discussed may be of considerable value to engineers and pattern makers irrespective of nationality.—H. A. Schwartz.

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Lukens Rolls Largest and Heaviest Plate

The Lukens Steel Company produced the largest and heaviest steel plate ever rolled up to the present time on Dec. 26th, on its 206-inch four-high reversing plate mill, the largest plate-rolling mill in the world.

The plate was reduced from a carbon steel ingot weighing approximately 92,130 lbs. produced in their open hearth. The sheared dimensions of the large plate are 195″ in width, $360^3/_4$″ in length and $2^3/_8$″ in thickness. It weighes approximately 48,200 lbs. Rolling mill operations were in charge of R. W. Simpson, Superintendent of Mills.

PATENT DEPARTMENT

An arrangement with Mr. W. M. Corse, Metallurgical Engineer, Washington, D. C., who operates an Engineering Information Service, enables us to publish a list of important patents from the United States, Canada, England, Germany, France, Switzerland, Denmark, Holland, Sweden, Norway and Italy. Copies of patents and translations will be supplied at reasonable cost. Patent searches made at minimum rates. Estimates cheerfully given. Information about this service may be secured by writing to the Patent Department, **Metals & Alloys**, 810 Eighteenth Street, Washington, D. C.

United States Patents

Note: Numbers of Reissue Patents are preceded by "Re."

Subject of Invention, Patentee, Patent No. and Filing Date.

Furnace conveyer. G. F. Beach, 1,782,335, original filed 4/8/26, divided and filed 6/1/27.

Method of welding copper boiler heads. A. H. Trageser & L. Hassinger, 1,782,373, 10/29/29.

Electric melting furnace. F. Linnhoff, 1,782,359, 2/7/29; Germany 2/11/28.

Recovering metals. U. A. Garred, 1,782,418, 4/8/27.

Heat-treating furnace. H. L. Waisner, 1,782,451, 11/7/27.

Welding machine. V. J. Chapman, 1,782,461, 1/24/28.

Annealing furnace. G. B. Shipley & H. Alinder, 1,782,481, 1/4/29.

Apparatus for heating a pickling solution. W. C. Siefert & G. W. Pawel, 1,782,482, 8/28/28.

Hydraulic press particularly for testing materials. A. J. Amsler, 1,782,595, 7/5/29; Germany 5/14/29.

Electrodeposition of metals. J. Hollins, 1,782,614, 1/22/29; Great Britain 2/25/28.

Electrolytic apparatus for refining aluminum and for like processes. P. L. Hulin, 1,782,616, 6/19/28; Germany 7/4/27.

Molding machine. T. O. Morris & J. J. Lawlor, 1,782,762, 6/1/27, renewed 2/8/30.

Treating copper ores preparatory to leaching. C. E. Carstens, 1,782,841, 8/17/25.

Casting machine. C. E. Hunter & De L. Lutz, 1,782,898, 4/30/30.

Apparatus for the electro deposition of iron. R. D. Pike, 1,782,909, 7/20/26.

Apparatus for casting zinc slabs and the like. D. M. Gray & J. J. Williams, 1,782,920, 10/27/28.

Purifying pig iron. K. Hofmann, 1,782,923, 5/9/29; Germany 5/25/28.

Apparatus for charging furnaces and the like. F. C. Biggert, Jr., 1,782,955, 1/7/27.

Rotary-hearth furnace. A. D. Dauch, 1,782,956, 3/20/26.

Means for rolling tubes. A. T. Keller, 1,782,968, 2/4/27.

Rod for use in arc welding or cutting. J. B. Green, 1,783,013, 2/10/27.

Process for the separation of cobalt and iron from solutions rich in iron as obtained by lixiviating roasted pyrites. N. E. Lenander, 1,783,046, 6/27/29; Germany 7/26/26.

Centrifugal casting machine. W. D. Moore & W. Morgan, 1,783,094, 6/4/28.

Ladle-tipping device for casting machines. W. Morgan, 1,783,128, 12/7/28.

Continuous soldering. M. Orenstein, 1,783,134, 2/9/29; Germany 2/15/28.

Alloy. (Cu–Ni–Zn). C. Philippossian, 1,783,139, 8/14/29; Switzerland 11/3/28.

Roller-mill guide. (Ni–Cr steel). M. Gorham, 1,783,148, 5/7/28.

Electric heating furnace. R. E. Talley, 1,783,155, 6/2/27.

Heat-treating apparatus. R. E. Talley, 1,783,156, 5/11/28, renewed 6/13/30.

Pickling crate. C. W. Haller, Re 17,882, (Original 1,711,054, filed 4/30/29) 3/26/30.

Method of making drums. W. A. Jones, 1,782,899, 3/19/26.

Method of coating metal surfaces. J. S. George & R. S. Sperry, 1,783,188, 12/23/26, original 8/11/25.

Process and apparatus for making bullets. S. Rousseau, 1,783,261, 9/3/26.

Furnace cooling by steam. H. F. Easter, 1,783,284, 3/9/28.

Mold. W. G. Goodwin, 1,783,285, 9/10/28.

Attachment for welding machines. E. W. Little, 1,783,337, 6/24/29.

Stereotype-plate-cooling apparatus. O. C. Roesen, 1,783,345, 3/5/27.

Method of electrically welding tubular articles. W. E. Crawford, 1,783,411, 5/8/29.

Blast furnace. J. P. Dovel, 1,783,416, 1/7/29, original 7/28/27.

Apparatus for coating wire. C. D. Johnson, 1,783,429, 6/22/29.

Process of making bearings. C. H. Landers, 1,783,438, 1/16/26.

Method of heating rolls. W. Schötteldreier, 1,783,524, 8/5/27, Germany 8/7/26.

Tube-transporting device. O. Bamberger, 1,783,555, 3/31/27.

Method of making electrically-welded tubing. J. W. Holt, 1,783,571, 4/18/27.

Apparatus for leaching and washing ores by the use of gas. A. B. Stevens, 1,783,591, 1/26/29.

Method of making cement-coated wire. J. B. Green, 1,783,613, 11/23/27.

Automatic soldering machine. J. E. Ferguson & W. A. Hoffman, 1,783,642, 11/2/28.

Etching precious metals. J. C. McFarland, 1,783,663, 6/22/28.

Manufacture of iron carbonyl. A. Mittasch & C. Müller, 1,783,744, 3/25/26, Germany 3/30/25.

Process of zone hardening steel articles. J. R. Adams, 1,783,764, 6/12/29.

Process of improving the resistance to corrosion of articles of magnesium and magnesium alloys. A. Beck & G. Siebel, 1,783,770, 1/30/29, Germany 2/2/28

Welding strip for golf shafts. H. C. Lagerblade, 1,783,802, 6/12/28.

Molding apparatus. F. J. Leuthner, 1,783,805, 8/2/29.

Apparatus for electrolytically depositing metal on metal tubes. F. G. Martin & W. Ramsey, 1,783,885, 9/29/27; Great Britain 4/22/27.

Soldering flux. H. C. Mougey, 1,783,925, 8/19/29.

Arc-welding apparatus. F. Lane, *et al.*, 1,784,015, 4/3/29.

Machine for welding. J. S. Newell, 1,784,024, 6/24/22.

Electrode Holder. (For welding electrodes.) J. H. Quisenberry, 1,784,075, 11/6/29.

Method of manufacturing electrically-welded vessels. R. Stresau, 1,784,080, 4/18/29.

Quenching tank. H. W. Fletcher, 1,784,095, 5/15/28.

Coating zinc and cadmium. A. Pacz, 1,784,106, 5/28/27.

Machine for babbitting sleeve bearings. C. H. Leis, 1,784,146, 12/28/29.

Compound mold for casting metal bodies. G. Bühler, 1,784,174, 10/29/28; Germany 11/4/27.

Annealing. J. R. Cain, 1,784,221, 8/2/27.

Core box. P. F. Devany, 1,784,225, 4/4/29.

Means for positioning mold pattern units. T. J. Flack, 1,784,345, 1/16/29.

Cooling means for castings. L. Förbus, 1,784,346, 12/24/29; Germany 1/2/29.

Water-cooled welding cable-joint construction. J. J. Paugh, 1,784,384, 4/29/29.

Continuous iron-temperature recorder. (*For molten iron.*) H. W. Dietert. 1,784,420, 7/12/26.

Rotary tempering furnace. E. Goerig, 1,784,427, 8/6/28; Germany 8/12/27.

Molding machine. W. Lewis, 1,784,457, 2/7/29.

Process for the recovery of the tin contained in the residues of tin-plate manufacture. J. Laley, 1,784,490, 4/3/28; France 1/23/28.

Method of cutting slots in metal. (*With a cutting jet.*) C. J. Coberly, 1,784,513, 7/10/29 (original 9/29/23).

Coating metal articles. F. M. Becket, 1,784,570, 10/29/28.

Forming die. R. J. Curtis, 1,784,579, 10/10/28.

Casting under pressure. S. Junghans, 1,784,600, 7/24/28; Germany 12/20/27.

Method of making crucibles. W. F. Whitney, 1,784,647, 11/3/26.

Apparatus for agglomerating and roasting minerals. A. de Samsonow, 1,784,658, 12/23/27; Belgium 1/4/27.

Electric furnace. A. Imbery, 1,784,670, 10/8/28; Great Britain 10/10/27.

Automatic charging of electric furnaces. P. L. J. Miguet, 1,784,699, 3/20/29; France 12/6/28.

Apparatus for preparing casting molds. B. L. M. van der Lande & G. Komen, 1,784,714, 3/26/28; Netherlands 8/27/27.

Rolling mill. K. Gruber, 1,784,791, 1/27/28; Germany 6/14/27.

Silicon steel. V. B. Browne, 1,784,811, 2/13/30.

Furnace and conveyer therefor. R. S. Cochran, 1,784,812, 4/23/28.

Magnetic material. G. W. Elmen, 1,784,827, 6/15/28.

Method of strain hardening manganese steel. F. A. Fahrenwald, 1,784,865, 12/13/26.

Method of strain hardening steel. F. A. Fahrenwald, 1,784,866, 3/24/27.

Method and apparatus for shipping metal. R. T. Romine, 1,784,909, 1/23/30.

Process of welding drills. F. O. Hoagland, 1,784,932, 2/1/28.

Process of producing chromic acid. M. J. Udy, 1,784,950, 12/16/27.

Cutting and welding torch. A. F. Jenkins, 1,784,964, 9/7/28.

Tank for chromium plating. C. R. Gleason, 1,784,987, 6/3/27, renewed 3/14/30.

Molding machine. T. O. Morris & J. J. Lawlor, 1,784,995, 3/12/29.

Metallurgical process. (*Treatment of molten Ni-Fe alloy.*) J. H. White, 1,785,060, 12/15/26.

Soldering flux. H. B. Dykstra, 1,785,115, 5/7/30.

Zinc-chloride-base flux. G. Lutz, 1,785,131, 12/26/29.

Soldering. H. S. McQuaid, 1,785,134, 12/26/29.

Flux for soft soldering. H. S. McQuaid, 1,785,135, 12/26/29.

Composite-metal article and method of making the same. C. W. Miller & R. E. Bissell, 1,785,137, 12/30/27.

Process of producing metallic cadmium from cadmium-containing material. H. H. Monroe, 1,785,139, 5/18/28.

Zinc-chloride-base flux. E. A. Taylor, 1,785,155, 12/26/29.

Multiple-stereotype-plate-casting machine. H. A. W. Wood, 1,785,164, 4/9/27.

Soldering flux. H. J. Barrett, 1,785,173, 5/7/30.

Flux for use in soldering. H. P. Corson, 1,785,180, 12/26/29.

Soft soldering flux. H. P. Corson, 1,785,181, 12/26/29.

Manufacture of low-carbon chrome steel. F. O. Kichline, 1,785,199, 4/20/26.

Removal of lead coatings from metallic articles. K. B. Bowman, 1,785,245, 10/8/29.

Magnetic material. W. F. Brandsma, *et al.*, 1,785,246, 8/1/28; Netherlands 7/19/27.

Recovery of metallic elements and alloys. H. M. Burkey & D. L. Ogden, 1,785,247, 8/15/28.

Process for producing lamelliform metal powders. E. Podszus, 1,785,283, 9/6/23; Germany 9/12/22.

Hot-metal car. C. P. Astrom, 1,785,292, 4/23/29.

Tin pot. J. T. McQuiston, 1,785,322, 1/12/27.

Alloy. (*Cu-Zn-Mn.*) J. N. White, 1,785,372, 11/12/29.

Process for controlling electroplating. R. J. Piersol, 1,785,389, 1/14/29.

Combined ore-reducing and hydro-carbon-refining apparatus. W. H. Smith, 1,785,427, 12/27/26.

Process of reducing ore and converting hydrocarbons. W. H. Smith, 1,785,428, 4/4/27.

Method of making plated shot. E. Pugsley, 1,785,493, 1/9/29.

Apparatus for desulphurizing cast iron. L. W. Spring, 1,785,503, 6/22/29 (original 6/16/28).

Solvent inhibitor for the acid treatment of metals. W. S. Calcott & I. E. Lee, 1,785,513, 4/17/29.

Open-hearth regenerative furnace. J. O. Griggs, 1,785,549, 4/1/29.

Manufacture or lining of pipes by centrifugal action. E. S. Hume, 1,785,586, 12/27/28; Australia 1/10/28.

Electrode joint. C. Kuhlmann, 1,785,587, 6/7/28; Germany 7/2/27.

Preliminary treatment of metal plates for the production of printing plates. F. Ullmann, 1,785,606, 3/7/27; Germany 3/10/26.

Metal pot for line-casting machines. L. W. Willis, 1,785,607, 7/5/29.

Apparatus for jarring ingot molds. L. Young, 1,785,757, 4/19/29.

Tinning apparatus. H. W. Bundy, 1,785,762, 12/4/25.

Plastic heat-treated aluminum alloy. N. V. Hybinette, 1,785,774, 5/18/29.

Pocketed welding, brazing, and hard-soldering rod. O. M. Krembs, 1,785,778, 3/11/29.

Method of rolling and annealing sheet metal. A. Paterson, 1,785,786, 3/26/28, renewed 5/14/30.
Crate for metallic sheets. J. R. Freeze, 1,785,863, 8/21/29.
Mold for casting metals. W. F. Eppensteiner, 1,785,941, 3/6/29.
Method of and apparatus for rolling sheet metal. J. R. Speer & F. H. Moyer, 1,785,986, 7/6/28.
Wire-testing machine. C. C. Sunderland, 1,786,138, 9/17/28.
Molding machine. R. F. Ringle, 1,786,171, 5/29/29.
Apparatus for high-temperature treatment of ores and other substances. M. Fourment, 1,786,202, 12/22/26; France 2/2/26.
Flask-handling device. S. D. Moxley, 1,786,218, 10/7/27.
Port construction and gas burner for open-hearth furnaces. G. F. Downs & H. F. Miller, Jr., 1,786,293, 11/4/20.
Rolling-mill housing. J. R. George, 1,786,296, 3/28/28.
Process of rolling alloy steel. H. M. Givens, *et al.*, 1,786,297, 11/20/29.
Extracting of tin from ores or materials containing tin. E. A. Ashcroft, 1,786,386, 5/4/28; Great Britain 6/24/27.
Method of producing ferromolybdenum and ferrotungsten. P. Schwarzkopf, 1,786,393, 4/29/29; Germany 5/22/26.
Protective metal coating and process and apparatus for producing the same. C. G. Fink & C. H. Eldridge, 1,786,398, 8/12/25, renewed 5/6/30.
Electric furnace. M. Unger, 1,786,322, 6/1/28.
Process for treating mill band saws. O. Muehlen, 1,786,444, 6/17/27.
Recrystallized refractory composition. T. S. Curtis, 1,786,482, 6/26/28.
Apparatus for and art of treatment of metal work. H. Rosenberg, 1,786,508, 6/20/29.
Electroplating apparatus. K. Baranowski, 1,786,592, 10/29/28; Great Britain 12/21/27.
Casting machine for battery grids. D. Pepper, 1,786,629, 6/4/29.
Molding machine. T. O. Morris & J. J. Lawlor, 1,786,672, 7/8/29.
Reduction of metal by rolling mills. A. Paterson, 1,786,775, 10/27/28.
Rolling mills. J. B. Tytus, 1,786,793, 5/20/25.
Process of refining iron and steel. S. Westberg, 1,786,806, 10/21/24.
Roll-polishing device. J. R. Byrum, *et al.*, 1,786,820, 3/24/28.
Furnace construction. H. Daum, 1,786,829, 7/10/28.
Rolling metal. D. Eppelsheimer, 1,786,834, 12/10/27.
Process for the separation and purification of metals and metallic alloys. (Sb from Pb alloys.) A. Hanak, 1,786,908, 8/8/28.
Method of operating carburizing apparatus. R. Kaier, 1,786,951, 8/18/28 (original 10/3/27).
Reduction of metals from ores. J. W. Hornsey, 1,786,999, 9/27/28 (original 11/25/25).
Seam-welding machine. W. H. Gibb, 1,787,039, 6/28/28.
Welding process. H. G. Spilsbury, 1,787,056, 8/27/27.
Welding machine. G. S. Lewis, 1,787,115, 5/18/28.
Method for making pure alumina by electrothermal reduction of the impurities in alumina-containing raw materials. H. Siegens, 1,787,124, 12/22/27; Germany 6/1/26.
Process of forming iron foils. J. R. Cain, 1,787,139, 6/11/26.
Galvanizing machine. J. Carroll, 1,787,141, 11/2/28.
Method of shaping edges for fusion welding. H. J. Grow, 1,787,247, 11/30/29.
Method of making sheet-metal bearings. W. H. Klocke, 1,787,255, 11/1/28, renewed 5/29/30.
Process of reducing ores. H. Wittek, 1,787,348, 12/1/26; Germany 7/26/26.
Steel alloy insensible to hot gases and vapors. B. Strauss, 1,787,403, 4/5/29; Germany 9/21/28.
Electric welding. J. F. Lawson, 1,786,759, 6/24/27.
Furnace. W. F. Detwiler, 1,787,307, 3/9/29.

Austrian Patents

Subject of Invention, Patentee, Patent No. and Date of Beginning of Term of Patent.

Process for making high-strength cast iron. K. Emmel, 120,382 (Addition to 113,306), 7/15/30.
Oxidation - and corrosion-resistant forgeable chrome-nickel steels. Poldihütte, 120,668, 5/15/27.
Process for separating alloys into their crystalline constituents. T. Kittl, 120,383, 7/15/30.
Process for making self-baking electrodes and for renewing them in service. Gebr. Siemens & Co., 120,380, 7/15/30.
Anode for the electrolytic recovering of pure aluminum from crude aluminum, aluminum alloys and the like. Aluminium Industrie Akt.-Ges., 120,386, 7/15/30.
Process for chromium-plating conducting objects. Soc. Nouvelle de l'Orfevrerie d'Ercuis, 120,388, 7/15/30.
Process for forming metal deposits. O. Lefnaer, 120,400, 7/15/30.
Etching machine. Hoh & Hahne, 120,379, 7/15/30.
Process for coating delicate goods with metals by electrode sputtering in a vacuum, with simultaneous cooling. Ges. für Elektrodenzerstäubung m. b. H., 120,656, 7/15/30.
Process and mandrel for pressing metal tubing. K. Hildebrand & O. Pflanzer, 120,359, 7/15/30.
Process for improving the mechanical properties, especially the compressive yield point, of products made of magnesium and magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 120,375, 7/15/30.
Transformer for electric welding installations. Ateliers de Construction Electriques de Charleroi S.A., 120,339, 7/15/30.
Device for regulating the rate of feed of the wire in arc welding machines. A. E. G. Union Elektricitäts Ges., 120,358, 7/15/30.
Flexible-shaft drive for tool holders guided by a template, particularly those of autogenous welding and cutting machines. A. Schmidt, 120,367, 7/15/30.
Fuel tank for soldering torches and the like. M. J. R. Metallwarenfabrik Josef Rosenthal Akt.-Ges., 120,371, 7/15/30.
Arrangements of the welds in the welding of flanges to rolled-metal walls of tanks and the like. Akt.-Ges. vorm. Skodawerk in Pilsen, 120,373, 7/15/30.
Process for making hollow drill steels and the like by rolling or forging hollow billets. F. Hatlanek, 120,344, 7/15/30.
Process for pressing irregularly shaped objects, particularly parts of auto bodies. Edward G. Budd Mfg. Co., 120,346, 7/15/30.
Process for making sections of uniform wall thickness from strips of sheet metal. I. G. Farbenindustrie Akt.-Ges., 120,361, 7/15/30.
Process and apparatus for making rails with hardened heads. Vereinigte Stahlwerke Akt.-Ges., 120,342, 7/15/30.

British Patents

Note: When the date applied for differs from the date on which the application was lodged at the British Patent Office, the former date is given, followed by *.

Subject of Invention, Patentee, Patent No. and Filing Date.

Electrical induction apparatus applicable to resistance welding. J. Archard, 338,172, 11/26/28*.
Tuyères for blast furnaces. E. Pohl, *et al.*, 338,130, 5/10/29.
Manufacture of metallic sheet, strip, or wire. S. O. Cowper-Coles, 338,173, 5/16/29.
Electric furnaces. Carborundum Co., 338,131, 12/7/28*.
Device for the hot stamping of bolts and rivets of large dimensions. P. T. Kikot, 338,148, 8/8/29.
Extraction of tin from ores, alloys, scrap, or the like. Soc. D'Electro-Chimie, D'Electro-Métallurgique, et des Aciéries Electriques D'Ugine, 338,149, 6/22/29*.
Refining of iron or steel. F. Krupp Akt.-Ges., Friedrich-Alfred-Hütte, 317,373, 8/14/28*.
Producing colored protective layers on the surface of aluminum-alloys, and articles made of aluminum alloys. A. Pacz, 338,204, 8/16/29.
Art of protectively treating metals. A. Arent, 338,221, 8/20/29.
Treatment of air-blast for furnaces. G. Malyoth, 338,244, 8/28/29.
Method of heat-treating nitrogenized alloy steel articles. R. Sergeson, 338,315, 10/18/29.
Electrodes of electric furnaces and electrolytic vats. P. Girod, 338,371, 8/27/29*.
Manufacture of iron and iron-nickel and iron-silicon alloys. Associated Electrical Industries, Ltd. 338,409, 1/18/29*
Apparatus for drawing metal tubes. Soc. M. Bassot et Cie., 338,415, 1/24/29*.
Method of manufacturing crank shafts or cranks. Vereinigte Stahlwerke A.-G. 338,439, 3/15/29*.
Alumino-thermic process for the generation of highest temperatures. E. Blümner, 338,468, 3/11/30.
Coating especially adapted for filming tin and like foil. Staniofabrik Burgdof A.-G., 338,340, 10/9/29*.
Process and apparatus for the electrodeposition of metals. S. O. Cowper-Coles, 338,487, 5/15/29*.
Electrolytic production or separation of tin. Siemens & Halske Akt.-Ges., 338,488, 5/16/29.
Blow-pipe-burner machines for cutting or welding metals. Akt.-Ges. für Tiefbohrtechnik und Maschinenbau vorm. Trauzl & Co., 312,193, 5/19/28*.
Journal bearing and method of manufacture. Kalif Corp., 338,505, 7/19/29.
Method of and means for annealing crystalline substances. E. G. Herbert, 338,511, 8/16/29.
Production of metals and apparatus for use in the same. J. E. Fletcher, 338,-535, 8/19/29.
Process and apparatus and processes for the treatment of ores or materials containing copper and/or nickel. E. A. Ashcroft, 338,556, 8/20/29.
Manufacture of pointed tubular metal articles. S. J. Everett, 338,592, 8/22/29.
Steel alloys. Nitralloy, Ltd., 338,655, 10/9/28*.
Non-ferrous alloys. G. H. Whiteman, and Imperial Chemical Industries, Ltd., 338,676, 10/14/29.
Making or re-melting alloys of aluminum and iron. British & Dominions Feralloy, Ltd., & J. W. Bampfylde, 338,688, 10/21/29.
Method of rolling down metal bands and sheets in the hot state to thin gauges. L. E. Broemel, 338,771, 12/18/29.
Regenerative furnaces. O. Reiner, 338,788, 1/10/29*.
Machines for casting stereotype plates. C. Winkler, 338,802, 1/23/30.
Electro-deposition of metals. S. O. Cowper-Coles, 338,540, 5/15/29*.
Method of treating tin-containing material. Mitsubishi Kogyo Kabushik. Kaisha, 316,177, 7/24/28*.
Heat-treatment for hardened steel. Vereinigte Stahlwerke A.-G., 314,056, 6/22/28*.
Changing a simple element into other simple elements of lower atomic weight. P. de Prat, 314,427, 6/27/28*.
Aluminum alloy. H. J. Garrard, 338,923, 5/30/29.
Treatment of cast iron. Link-Belt Co., 338,924, 5/31/29.
Ferrous metal or alloy. Link-Belt Co., 338,925, 5/31/29.
Heating furnaces suitable for metallurgical purposes. R. A. Hadfield & R. J. Sarjant, 338,893, 6/26/29.
Manufacture and production of aluminum. I. G. Farbenindustrie A.-G., 338,668, 7/4/29.
Apparatus for extruding and coiling rods. Scovill Mfg. Co., 338,948, 8/22/29.
Electrodes for electrolytic purposes. Electro-Chemische Industrie, 318,154, 8/23/29.
Blast roasting or sintering of ores and metallurgical materials. National Processes, Ltd., & T. B. Gyles, 338,886, 8/27/29.
Heat-treatment of alloy irons and steels. P. R. Kuehnrich & Darwins Ltd., 338,912, 8/22/29.
Manufacture of steel having good machining properties. F. Borggräfe, 318,177, 8/29/28*.
Methods of lining pipes, more particularly the exhaust-pipes of gas engines. Gutehoffnungshütte Oberhausen A.-G., 318,179, 8/29/28*.
Pouring-trough for centrifugal metal-casting apparatus. Ferric Engineering Co., 339,017, 11/7/28*.
Die-casting machines. Krone-Sebek Die Casting & Manufacturing Co., 339,023, 9/19/29.
Blow-pipes, for cutting and welding, of the liquid-fuel-fed type. G. Lotzow, *et al.*, 339,037, 10/3/29.
Process of and machines for casting metal pipes. Soc. Anon. des Hauts Fourneaux et Fonderies de Pont-à-Mousson, 339,095, 12/20/28*.
Method of and heating-apparatus for the heat treatment of wire and stip prior to galvanizing or other form of surface treatment. L. D. Whitehead, 339,-155, 1/6/30.
Welding. Budd Wheel Co., 339,228, 4/25/29*.
Simultaneous reduction of ores and conversion of carbonaceous materials into hydrocarbons of low boiling point. J. L. Fohlen, 339,276, 7/25/29.
Production of continuously-burning, parallel-arranged electric arcs. I. G. Farbenindustrie Akt.-Ges., 339,329, 7/29/29.
Applying a metal coating to aluminum by galvanic means. M. K. De Trairup, 339,339, 9/3/29.
Manufacture of iron pans for zinc baths. N. O. Midderman, 339,384, 9/20/29.

Method of and apparatus for making articles by electrolytic deposition of galvanoplastic metal. G. Rosenqvist, 339,428, 10/24/29.
Aluminum alloy. O. Kamps, 339,469, 11/25/29.
Preparation of magnesium by electrolysis. Dow Chemical Co., 339,504, 12/17/29.
Heat treatment of manganese steel. Taylor-Wharton Iron & Steel Co., 339,-521, 12/31/29.
Welding of metal pipes or tubes. H. Mayweg, 339,570, 3/10/30.
Treatment of a molten mass of metal or alloy, particularly a mass of molten steel in a ladle. F. Krupp Akt.-Ges., 339,579 (Addition to 312,063), 4/30/29*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Reinforcement of welded joints. Executors of W. J. Gamble, 305,755, 11/2/29.
Refractory materials for furnace linings. G. M. Carrie & A. C. Halferdahl, 305,757, 12/22/28.
Flux for soldering. J. H. Gravell, 305,783, 11/18/30.
Vibrating apparatus for removing patterns and castings from sand molds. C. B. Pike, 305,807, 12/17/28.
Protection of metal bodies from corrosive agencies. P. F. Schade, 305,812, 2/21/30.
Aluminum solder. C. F. W. Schwarz, 305,814, 7/13/29.
Method of treating solid materials (ores) with gases. F. M. Wiberg, 305,827, 9/18/29.
Process of electrodepositing metals of the platinum group. Baker & Co., Inc., 305,840, 5/15/30.
Electrodeposition of platinum metals. Baker & Co., Inc., 305,841, 5/15/30,
Hard metal composition. The Canadian General Electric Co., Ltd., 305,847, 3/7/28.
Manufacture of refractory articles. The Carborundum Co., 305,865, 11/24/28.
Process of reducing iron ores. The Davis Steel Process Corp., 305,871, 7/11/29.
Process of producing iron or steel directly from the ore. Same patentee, 305,-872, 7/11/29.
Rust-proofing material. The Parker Rust Proof Co., 305,928, 2/24/30.
Treatment of beryllium. Skinner & Sherman, Inc., 305,937, 10/22/29.
Mill roll. W. C. Oberg, 305,963, 1/2/29.
Ingot stripping mechanism. The Alliance Machine Co., 306,049, 6/14/29.
Method of strain hardening steel. The American Manganese Steel Co., 306,051, 4/4/28.
Digging tool with hard metal cores. Same patentee, 306,052, 11/14/29.
Steel (pearlitic manganese steel). The American Steel Foundries, 306,054 & 306,055, 8/28/29.
Process of refining lead-bismuth alloys. The Consolidated Mining & Smelting Co. of Canada, Ltd., 306,082, 5/9/29.
Process of recovering metals from the slimes of electrolytic lead refining operations. Same patentee, 306,083, 5/28/29.
Metal bar cooling bed. The Mesta Machine Co., 306,111, 6/23/30.
Process of plating brass with chromium. The Metals Protection Corp., 306,112, 9/20/29.
Method of heat treating rods, etc. F. A. Fahrenwald, 306,165, 6/27/29.
Bearing metal (lead-alkaline earth alloy). W. Mathesius & M. W. Neufeld, 306,173, 3/12/27.
Production of steel abrasive materials. S. D. Layton, 306,226, 2/19/30.
Apparatus for casting light metals. E. Roth, 306,246, 11/26/29.
Anti-corrosive process for metals. (Deposition of antimony.) The Arthur Arent Laboratories, Inc., 306,271, 5/27/29.
Refractory metal body. The Canadian Westinghouse Co., Ltd., 306,285, 4/30/27.
Process of producing rare metals. Same patentee, 306,286, 7/30/27.
Resistance alloy (chromium-tungsten). Same patentee, 306,287, 9/9/27.
Soldering machine. Same patentee, 306,292, 6/22/29.
Production of refractory articles. Same patentee, 306,297, 11/27/29.
Method of refining copper. The Western Electric Co., Inc., 306,406, 2/7/29,
Chaplet. The Fanner Mfg. Co., 306,425, 5/22/30.
Foundry molding machine. The British Insulated Cables, Ltd., 306,528, 9/24/29.
Method of treating tungsten filaments. The Canadian Westinghouse Co., Ltd., 306,544, 4/30/27.
Cast iron converter. La Carbonisation Soc. Générale d'Exploitation des Carbones, 306,579, 1/5/29.
Ferrous metal. Link-Belt Ltd., 306,582, 3/22/29.
Lead alloy. (Aged alloy containing 0.1% Ca.) The Western Electric Co., Inc., 306,610, 4/22/29.

Danish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for changing the shape of hollow metal bodies and for improving the structure of the metal. United States Cast Iron Pipe & Foundry Co., 43,332, 6/22/29.
Tilting furnace. Siemens & Halske Akt.-Ges., 43,358, 1/10/30.
Process for making pipe by electric butt welding. F. A. Frisch, *et al.*, 43,372, 1/14/29.
Process for recovering zinc and other volatile metals from their ores. H. E. Coley, 43,375, 1/10/29.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Machine for bending iron sections. A. François & H. J. Cousin, 696,750, 6/6/30.
Machine for bending iron bars. H. Binet, 697,083, 6/4/30.
Improvements to methods of producing and refining ferrous metals. Syndicat des Laitiers et Scories, 696,779, 9/11/29.
Process for roasting and pyrogenetic agglomeration of concentrated pyrite and sulfidic iron materials. A. Folliet & N. Sainderichin, 697,006, 5/26/30.
Alloy steels and objects which are resistant to corrosion by particularly active solutions. Fried. Krupp Akt.-Ges. & Heinrich Koppers Akt.-Ges., 697,053, 6/2/30.
Improvements to methods for producing sponge iron. I. Rennerfelt & I. C. S. G. Bohm, 697,058, 6/3/30.
Process for annealing steel. H. Hanemann, Addition 37,678 (2nd addition to 667,217 filed 1/10/29), 5/23/30.
Improvements to hard metallic compositions and to processes for making them. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, Addition 37,695 (3rd addition to 654,210 filed 4/4/28), 9/26/29.
Process for refining nickel, copper and copper-nickel alloys. H. J. M. E. Clerc, Addition 37,713 (2nd addition to 669,109 filed 6/1/28), 5/28/29.
Method of preheating scrap iron for welding. A. Dossmann, 696,679, 6/5/30.
Gasoline soldering torch. S. Milioni, 696,720, 6/6/30.
Process and machine for making metal tubes with ends thickened by upsetting. Mannesmannröhren Werke, 696,836, 6/7/30.
Bar for the production of heat treated objects. A. B. Svenska Kullagerfabriken, 696,855, 6/7/30.
Casting machine. R. Rondel & G. Iochum, 696,976, 5/17/30.
Improvements to processes and to equipment for making wrought iron. A. M. Byers Co., 697,098, 6/4/30.
Methods and device for making large chain links by electric welding. Henri Davaine Fils & Co., 697,125, 6/6/30.
Improvements to electric furnaces. Wild Barfield Electric Furnaces, Ltd., 696,853, 6/7/30.
Improvements to electrolytic apparatus. A. E. Knowles, 697,043, 5/31/30.
Improvements to the method of propagating electrothermic reactions. Buffalo Electric Furnace Corp., 697,108, 6/5/30.
Overload safety device for rolling mills, presses and the like. E. Svatos, 697,-365, 6/26/29.
Process for making tools. Fried. Krupp Akt.-Ges., 697187, 6/11/30.
Wire-drawing die. Vereinigte Stahlwerke Akt.-Ges., 697,351, 6/13/30.
Process for improving the mechanical properties, for example the yield point and fatigue bending strength of austenitic iron-chromium-nickel-carbon alloys. Fried. Krupp Akt.-Ges., 697,188, 6/11/30.
Treatment of zinciferous materials containing cadmium. The New Jersey Zinc Co., 697,217, 6/11/30.
Improvements in the treatment of slag. Det Norske A/S for Elektrokemisk Industri, 697,403.
Means for cementing cast metal scrap. A. Gourgaud, addition 37,740 (1st addition to 664,565 filed 11/22/28), 11/5/29.
Process for forming a metallic coating on any kind of object. H. Mayr, 697,211, 6/11/30.
Process for producing metals having a corrosion-resistant layer. Vereinigte Stahlwerke Akt.-Ges., 697,297, 6/12/30.
Device for extracting metal pipes and the like. P. Dunsheath, 697,306, 6/-13/30.
Process for metallizing objects of organic origin by metallic vaporization. K. Richter, 697,308, 6/13/30.
Process for forming thin coatings on any kind of object. K. Richter, 697,309, 6/13/30.
Improvements to rotary furnaces. R. P. E. Roman & T. Lafitte, 697,373, 4/23/30.
Improvements to special compositions for making tools and the like. Firth Sterling Steel Co., 697,611, 6/18/30.
Improvements to processes and to means for rectifying surfaces such as those of sheet metal and the like. Bleriot Aeronautique, 697,619, 6/18/30.
Process for treating rails or other massive objects. Bethlehem Steel Co., 697,529, 6/17/30.
Improvements to ingot molds. Firth Sterling Steel Co., 697,552, 6/17/30.
Improvements to processes for reducing oxides and other compounds of iron. M. Amoroso & Società Anonima Metalfer, 697,626, 6/18/30.
Improvements to processes for rolling sheet metal. The American Rolling Mill Co., 697,664, 6/19/30.
Improvements to processes for working metallic objects. Firth Sterling Steel Co., 697,670, 6/19/30.
Process for improving the resistant qualities of magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 697,747, 6/21/30.
Fire-resistant and corrosion-resistant alloy steel. T. Czepl, 697,801, 6/23/30.
Rolling mill drive. A. Schopf, 697,805, 6/23/30.
Process for making high strength steels. M. Stern Akt.-Ges., 697,811, 6/23/30.
Improvements to water-jacketed shaft furnaces. Soc. An. Le Nickel, 697,962, 9/30/29.
Device for placing the work in the dies of horizontal forging machines. Maschinenfabrik Hasenclever Akt.-Ges., 697,438, 6/16/30.
Process and devices for making sheet metal longerons. Boisvert & Aran, 697,-520, 6/16/30.
Improvements to welding machines. Ford Motor Co., Ltd., 697,583, 6/17/30.
Cast iron tappets and the like and process for making them. Ford Motor Co, Ltd., 697,631, 6/18/30.
Method of joining metals which are very hard to cut. R. Braun, 697,655. 6/19/30.
Bolts, wrist-pins, and the like obtained by swaging tubing. R. Charbonnier, 697,687, 6/19/30.
Improvements to stamping dies. Edward G. Budd Mfg. Co., 697,754, 6/21/-30.
Apparatus for examining crystalline substances with the aid of X-rays. N. V. Philips' Gloeilampenfabrieken, 697,731, 6/20/30.
Improvements to anodes. Udylite Process Co., 697,728 & 697,729, 6/20/30.
Muffle furnace. M. Ducroquet & R. Gillain, 697,610, 6/18/30.
Improvements to tunnel furnaces. Woodall Duckham, Ltd. & A. M. Duckham, 697,639, 6/18/30.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for making weld iron. A. Dossmann, 513,732, 4/27/28.
Gas-heated, doorless hardening furnace with vertically or horizontally disposed preheating, hardening and tempering chambers. E. Reimann, 513,601, 6/15/28.
Process for making cores of hard iron powder. Weitverkehrskabel G. m. b. H., 513,761, 12/24/27.
Heat-resistant coils and windings. I. G. Farbenindustrie Akt.-Ges., 513,689, 12/29/28.
Process for making electric heating elements. Voigt & Haeffner Akt.-Ges., 513,607, 9/6/27.
Means for interchanging heating-element holders in electric furnaces. E. F. Russ, 513,762, 8/5/27.
Two-piece chaplet. E. Sonnet, 513,737, 5/5/27.
Process for producing non-porous castings of alloys containing copper by the addition of a copper compound. A. Kirchhof, 513,738, 4/16/24.

Decomposing stanniferous raw material. W. Poetsch, 513,697, 8/15/28.

Lead-base bearing metal. W. Mathesius & M. W. Neufeld, 513,623 (Addition to 441,071), 4/27/26.

Process for plating objects with chromium. Metals Protection Corp, 513,742, 7/3/27; U. S. 9/9/26.

Device for cutting or welding metallic bodies with curved surface and varying thickness. Akt.-Ges für Tiefbohrtechnik u. Maschinenbau vorm. Trauzl & Co., & F. L. Müller, 513,715, 8/6/29; Austria 7/13/29.

Method of finishing hammer- or press-forged shafts. E. Kamp, 514,148, 6/27/28.

Mandrel lock for tubing mills. Maschinenfabrik Meer Akt.-Ges., 514,243, 3/8/29.

Roll setting device for cold-rolling mills. Demag Akt.-Ges., 513,989, 8/12/28,

Rolling mill for making metal balls out of heated pre-pressed blanks. O. Rump, 513,939, 4/11/29.

Electric annealing furnace. Siemens-Schuckertwerke Akt.-Ges., 514,235, 7/1/28.

Method of operating a heat treating furnace fired either with gas or coal dust as desired. T. Wuppermann, 514,017, 5/9/28.

Leads from the transformer to the electrodes of three-phase furnaces. Siemens-Schuckertwerke Akt.-Ges., 514,193, 7/24/28.

Process and machine for making pipes, cylinders and the like by centrifugal casting. Ostermann & Flüs Akt.-Ges., 514,201, 5/27/28.

Process for making hollow bodies by centrifugal casting in green sand molds. S. A. des Hauts-Fourneaux & Fonderies de Pont-à-Mousson, 514,153, 9/13/25.

Water-cooled chill molds for casting slabs, billets, bars and pipes. A. Mohr, 513,930, 10/27/27.

Drive for the piston of a die casting machine. Braunschweiger Hüttenwerk G. m. b. H., 514,202, 3/2/30.

Process for electrolyzing halogen salt melts. I. G. Farbenindustrie Akt.-Ges., 514,125, 4/27/29.

Improvements of alloys of noble metals. Deutsche Gold- u. Silber-Scheideanstalt vorm. Roessler & W. C. Heraeus, 514,126, 4/18/25.

Electrolytic process for cleaning the surfaces of metallic objects. M. Wommer, 514,157, 2/3/27.

Welding process. M. Polanyi, 514,289, 1/18/29.

Electrically-driven roller, particularly for rolling mill roller beds. Siemens-Schuckertwerke Akt.-Ges., 514,646 & 514,647, 5/8/29 & 5/18/29.

Hydraulic extrusion press. Fried. Krupp Grusonwerk Akt.-Ges., 514,735, 7/27/28.

Process for making seamless cylindrical hollow bodies. W. Schroer, 514,584. 4/27/29.

Draw-press. The Toledo Machine & Tool Co., 514,585, 3/24/27.

Process for decomposing chromium ore with gases containing hydrogen chloride. I. G. Farbenindustrie Akt.-Ges., 514,743, 4/17/27.

Process for preventing hypereutectoid carburization in the cementation of steel H. I. Schiffler, 514,479, 3/19/27.

Electric annealing furnace. Akt.-Ges. Brown, Boveri & Cie., 514,353, 4/19/28.

Melting, calcining or heating furnace. Heraeus-Vacuumschmelze Akt.-Ges. & W. Rohn, 514,354, 12/19/25.

Self-baking electrode. Det Norske A/S for Elektrokemisk Industri, 514,575, 5/7/26; Norway 5/15/25.

Wire-feed device for arc welding machines. Allgemeine Elektricitäts Ges., 514,759, 11/24/28; U. S. 11/23/27.

Induction furnace with rammed melting hearth. E. F. Russ, 514,357, 12/12/29.

Portable sand-projecting machine. W. Seidemann, 514,767, 8/20/28.

Double molding machine. Badische Maschinenfabrik & Eisengiesserei, 514,768, 5/9/30.

Device for indicating the amount of metal in a chill mold. H. Kamps & H. Zepernick, 514,358, 4/11/29.

Method of securing the cover plates of chill molds. Aluminium Ltd., 514,359, 12/7/28; U. S. 1/27/28.

Two part mold for die casting. S. Junghans, 514,360, 1/8/29.

Process and device for melting metallic waste. Hirsch, Kupfer & Messingwerke Akt.-Ges., 514,442, 1/20/29.

Working up ores and intermediate products containing zinc, lead and copper. A. F. Meyerhofer, 514,537, 12/24/24.

Refining agent for type-metal alloys and process for preparing the same. E. Hoffmann, 514,726, 1/3/28.

Continuous process for separating and refining metals or metallic compounds with different melting points. Hirsch, Kupfer & Messingwerke Akt.-Ges., 514,612, 8/31/28.

Working up fine ores or metallurgical products, particularly lead-bearing dust, Metallges. Akt.-Ges., 514,679, 4/29/27.

Process for the electrolytic recovery of metals, particularly tungsten. H. Hartmann, 514,365, 9/11/28.

Improving silver-copper and silver-copper-cadmium alloys. Deutsche Gold- u. Silber-Scheideanstalt vorm. Roessler, 514,772, 4/7/26.

Salt bath for annealing metal objects. W. Frey & Co., 514,366, 1/31/30.

Immersion pyrometer for molten metals. R. Hase, 514,682, 5/11/29.

Electrolytic process for the formation of protective layers of lead peroxide. Siemens & Halske Akt.-Ges., 514,621, 10/23/27.

Welding of pipes meeting at an angle. A. Pozdena, 514,490, 3/4/28; Czechoslovakia 3/8/27.

Method of welding tubing tangentially to surfaces to be cooled or heated. R. Samesreuther, 514,550, 8/13/26.

Cutting or welding machine. Akt.-Ges. für Tiefbohrtechnik & Maschinenbau vorm. Trauzl & Co., 514,551, 8/6/29; Austria 7/13/29.

Process for making finely granulated metal from molten metal. Hartstoff-Metall Akt.-Ges., 514,623, 12/6/28.

Method of making tableware with reinforced places. M. Schmitz, 514,553, 4/3/30.

Dry backfire check for welding burners. O. Wolf, 515,009, 8/31/29.

Device for placing on the tips of autogenous cutting and welding burners. H. Jass, 515,194, 12/4/29.

Mandrel arrangement for rolling mills. Mannesmannröhren-Werke, 515,176, 6/15/27.

Extrusion press. Adolf Kreuser G. m. b. H., 514,819, 11/9/29.

Process for drying the blast for shaft furnaces, particularly blast furnaces. G. Malyoth, 515,216, 10/5/26.

Tilting device for drum furnaces, drum forehearths and mixers rotating about their longitudinal axes. Gewerkschaft Eisenhütte Westfalia, 515,041, 1/10/29.

Production of acid- and rust-proof objects. Poldihütte Akt.-Ges., 514,944, 9/2/23.

Process for heat treating the cores of loading coils, especially those made of high permeability materials. International Standard Electric Corp., 514,912, 8/9/27; U. S. 11/15/26.

Furnace for the production of aluminum. P. E. Fröland, 515,229, 3/6/28; Norway 3/12/27.

Method of annealing large metal billets. C. Lorenz Akt.-Ges., 515,013, 7/3/28.

Blast ducts for cupolas. F. Schinke, 515,239, 3/21/29.

Process for casting in liquid-cooled permanent molds. H. A. Schwartz, 514,-875, 3/4/24.

Device for extracting pipes or similar cylindrical objects from molds. Centrifugal Castings Ltd., 515,138, 12/11/28; Great Britain 1/17/28.

Centrifugal casting machine for making hollow bodies in horizontal molds. A. Possenti & C. Scorza, 515,139, 8/14/29; Italy 4/4/29.

Aluminum furnace having a magnetic stirring device. H. Thoma, 514,919, 12/4/28.

Machine for bending tubing. H. Westerbarky, 515,158, 3/25/28.

Cutting and welding burner using liquid fuel. S. Weil & G. Lotzow, 515,537, 5/23/29; France 5/2/29.

Sheet metal folding machine. A. Kramlowski, 515,381, 5/8/29.

Device for feeding tubing to expanding rolls. Mannesmannröhren-Werke, 515,303, 11/27/29.

Crank or eccentric presses, particularly extrusion presses. L. Schuler Akt.-Ges., 515,462, 1/17/29.

Process for making annular depression in metal sheets. Firma Eduard Theisen, 515,445, 12/28/26.

Process for making metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 515,464, 8/19/28.

Device for pounding material out of rotary furnaces. Gewerkschaft Eisenhütte Westfalia, 515,392, 11/24/29.

Method of improving the operation of shaft furnaces and other melting furnaces. Vulcan-Feuerung Akt.-Ges., 515,315, 9/6/27.

Process for making objects that are composed partly of white gold. Deutsche Gold- u. Silber-Scheideanstalt, vorm. Roessler, 515,579, 10/15/26.

Machine for bending iron bars, etc., E. Kibler, 515,582, 6/13/28.

Cutting or welding apparatus. Akt.-Ges. für Tiefbohrtechnik u. Maschinenbau, 515,354, 8/6/29; Austria 7/13/29.

Italian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for reducing zinc and other volatile metals from their ores and the like. H. E. Coley, 271,922, 8/18/28, Great Britain 9/14/27.

Improvements to processes for heat treating metals, and apparatus in which use is made of a mass of molten metal. C. F. Hammond & W. Shackelton, 271,504, 7/26/28.

Method and apparatus for the electrolytic deposition of metals. E. Kelsen, 271,622, 7/24/28.

Process for deforming a crystalline metallic body. N. V. Philips' Gloeilampenfabrieken, 271,921, 8/18/28, Netherlands 6/21/28.

Process for reducing sulfidic ores. H. Skappel, 271,881, 8/8/28.

Process for producing a material which is as little as possible subject to cold-shortness, ageing and blue-brittleness. Vereinigte Stahlwerke Akt.-Ges., 271,421, 8/6/28, Germany 8/6/27.

Process for producing a material (iron or steel) having little tendency to cold-shortness and blue-brittleness nor to become brittle when aged naturally or artificially. Same patentee, 271,744, 7/20/28, Germany 7/21/27.

Annealing box. Aciéries Réunies de Burbach-Eieh-Dudeloonge S. A., 271,-288, 7/11/28, Luxembourg 4/27/28.

Improvements to molds for die-casting metal objects, such as pistons. Aluminium, Ltd., 271,785–271,787, 8/6/28.

Casting process. Eisen u. Stahlwerk Walter Peyinghaus, 271,440, 8/6/28.

Process for refining metals, particularly iron and steel. Ges. für Industriegasverwertung m. b. H., 271,884, 8/20/28; Germany 9/28/27.

Improvements in the hardness testing of metals or in testing hardness with simultaneous hardening of the metal. E. G. Herbert, 271,833, 8/27/28; Great Britain 8/29/27.

Die casting process and machine for use with this process. S. Junghans, 271,-755, 7/20/28; Germany 12/20/27.

Process for producing metallic materials having a fibrous structure. Kaiser Wilhelm Institut für Eisenforschung e.V., 271,829, 8/24/28; Germany 9/10/27.

Process for increasing the elastic limit or ductility of structural elements made of strong and forgeable metals. G. Kérekyártó, 271,597, 7/18/29; Hungary 8/11/27.

Process for the bright chromium-plating of iron and aluminum objects. H. Leiser, 271,463, 7/21/28; Germany 7/21/27.

Casting machine. J. Polak, 272,097, 7/4/28.

Coating for arc welding electrodes. La Soudure Electrique Autogéne S.A., 271,759, 7/23/28; France 3/11/28.

New type of cast object and process and apparatus for producing the same. Temple, Inc., 271,446, 7/27/28; U. S. 8/1/27 (Patent No. 1,650,307).

Process for working down ingots and semi-finished non-round objects of steel and the like. H. A. Waldrich G. m. b. H., 271,531, 5/21/28; Czechoslovakia 4/15/22.

New type of bearing lined with antifriction metal and process for making it. Cleveland Graphite Bronze Co., 272,059, 8/16/28.

Method of making electrodes. Det Norske A/S for Elektrokemisk Industri, 271,391, 7/18/28; U. S. 7/19/27.

Apparatus for examining substances by means of X-rays. N. V. Philips' Gloeilampenfabrieken, 271,970, 8/23/28; Netherlands 2/28/28.

Shaft furnace for treating solid substances with gases. A/S Norsk Staal, 271,934, 8/22/28.

Improvements to high-voltage arc furnaces. A/S Norsk Staal, 271,980, 8/22/28.

Electric resistance for carrying heavy currents, particularly for electric furnaces. G. Malaguti, 271,549, 8/6/28.

Improvements to open-hearth furnaces. "Terni" Societá per l'Industria e l'Electricita, 271,270, 4/6/29.

Norwegian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for rolling thin strip iron and the like. C. Rötzel, 48,667, 5/4/28.

Process for converting liquid slags and the like into a porrous form. Dekt Nors. A/S foElektrokemisk Industrie, 48,692, 2/27/29.

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

201 **Stokers.**—The Combustion Engineering Corporation, 200 Madison Avenue, New York, has issued a new catalog describing the Type-E Underfeed Stoker manufactured by them. This stoker is applicable to boilers ranging from 150 hp. up to 600 hp. The catalog includes line drawings showing application of this stoker to various types of boilers.

202 **Flow Meters.**—The Brown Instrument Company of Philadelphia, Pa., is sending out an unusual card model illustrating the principle of their flow meters. This has on the back a table of pipe capacities.

203 **Die Casting Handbook.**—The object of this handbook is to supply general information to engineers who are already familiar with the die casting process. It contains data on the Stewart Die Casting Alloys. Stewart Die Casting Corporation, 4535 Fullerton Avenue, Chicago, Illinois.

204 **Nickel Alloy Steel Products.**—The International Nickel Company, Inc., 67 Wall Street, New York, N. Y., has published a 16-page Buyers Guide to these products, which is a tabulation of sources of supply for the more commonly used forged, rolled, cast or drawn products made from Nickel Steels and Alloys. This edition contains footnotes concerning the size ranges and production limitations of the various concerns listed.

205 **X-Ray Spectrograph.**—Dr. Müller's X-ray spectrograph is capable of being used for any of the principal methods of X-ray spectrography and crystallography in which photographic recording is made use of and in addition can be employed as an optical crystal goniometer. A booklet describing it is sent out by the Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London.

206 **Lead.**—The first issue of this periodical published by the Lead Industries Association, 420 Lexington Avenue, New York, describes a number of interesting uses of lead.

207 **Heat-Treating.**—The Surface Corporation, Toledo, Ohio, is distributing a reprint of an article entitled, 'Continuous Heat-Treating." This is a very complete description of their conveyor type automatically controlled furnace equipment with automatic fuel cut-outs and automatic timing devices.

208 **Gears.**—Book No. 1274 issued by the Link-Belt Company of Philadelphia, Pa., is a 16-page pamphlet descriptive of their recently announced all-metal variable speed transmission.

209 **Foundry Machines.**—The December issue of "Better Methods," published by the Beardsley & Piper Company, Chicago, Illinois, is devoted to a description of their units: sandslingers, sandmuller, sandarators, magnetic separators, and reciprocating riddles.

210 **Annealing Furnaces.**—The Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has just released a leaflet describing their rectangular and cylindrical bell type annealing furnaces. The advantages of these furnaces are close temperature control, controlled atmosphere and simplicity of operation.

211 **Sound Ingots.**—The Gathmann Engineering Company, Baltimore, Maryland, have compiled a 88-page book, "Ingot Contour and its Relation to Sound Steel." This is a very thorough discussion of the production of ingots for high quality steel. Price $1.00.

212 **Testing Machines.**—Herman A. Holz, of 167 East 33rd Street, New York, has issued a very interesting pamphlet discussing the Amsler Hydraulic testing machines versus lever types of machines.

213 **Plating Machines.**—Bulletin No. 313 is a very thorough discussion of the Meaker Straight-A-Way and Return Type Machines, indicating the economies effected by the use of this equipment. The Meaker Company, 1615 South 55th Avenue, Chicago, Illinois.

214 **Refractories.**—The E. J. Lavino and Company, Philadelphia, Pa., had a competent engineering firm survey their Plastic K-N and Kromepatch while in actual use. Copies of these surveys, LC-104-CZ, LC-109-AZ and LC-102-HZ, can be obtained upon request.

215 **Automatic Control.**—This booklet describes and illustrates how automatic control renders its aid as though it were humanly directing your process to meet changing operating conditions and requirements freeing the human element from its limitations. Brown Instrument Company, 4482 Wayne Ave., Philadelphia, Pa.

216 **Bearing Tester.**—This is a leaflet describing an acoustimeter for the inspection of ball and roller bearings. The function, operation and advantages of the Burgess Bearing Tester are also given. Burgess-Parr Company, 111 West Monroe St., Chicago, Ill.

217 **Oscillographs.**—Bulletin GEA-954A describes and illustrates the Cathode-Ray Oscillograph. This instrument has its principal use in the recording of extremely fast or transient phenomena. It can be used for the study of the effect of artificial lighting or by a slight modification, of natural lighting. General Electric Co., Schenectady, N. Y.

218 **Industrial Heating.**—A new publication covering Industrial Heating Equipment has recently been issued by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. Consisting of 100 pages it includes operating data, charts, tables and installation photographs in addition to specifications and illustrations of industrial heating equipment.

219 **Electroplating Aluminum.**—This instructive booklet issued by the Aluminum Company of America, Pittsburgh, Pa., gives in great detail the method of plating aluminum using different deposits. Several plates and tables make the book even more complete.

220 **Steam Generating Equipment.**—A sixteen-page catalog, GC-6, illustrates and briefly describes the fuel burning and steam-generating equipment manufactured by Combustion Engineering Corporation, 200 Madison Ave., New York. A complete list of C-E products is given.

221 **Tachometers.**—Catalog No. 46, issued by the Brown Instrument Company, Philadelphia, Pa., contains 16 pages with illustrations of Brown Indicating and Recording Tachometers in various models, together with the electric generators used in operating them. There are also illustrations and data covering standard applications of this equipment.

222 **Electrical Equipment.**—The General Electric Company, Schenectady, New York, has issued a number of new leaflets to be inserted in their GEA folder. These describe Resistor Arc Welders, Hand Starting Compensators, Fan-cooled Induction Motors, Magnetic Switches and Oil Circuit Breakers.

223 **Special Furnaces.**—A four-page folder sent out by the Surface Combustion Company, 2375 Dorr Street, Toledo, Ohio, describes an SC Car Bottom Annealing Furnace installed in the plant of the Link Belt Company.

224 **Coating Tanks.**—Bulletin No. 200 sent out by H. O. Swoboda, Inc. Pittsburgh, Pa., is a seven-page booklet discussing the "Falcon" electrically heated vertical large coating tanks for asphalts, tars, oils, varnishes and similar substances. Bulletin No. 170 is devoted to electrically heated compound melting tanks and Bulletin No. 190 to continuous electric furnaces for heat treating strip metal and wire.

225 **Brass Rod.**—A small folder published by the Titan Metal Manufacturing Company, Bellefonte, Pa., describes their Nittany Free Turning Brass Rod giving its chemical and physical properties as compared with six samples of other brass rods.

226 **The Laboratory.**—A recent issue of this publication by the Fisher Scientific Company, Pittsburgh, Pa., contains an article on a new atomizing pipette for use in gas analysis and a description of the Plug-Easer, a handy laboratory tool for loosening "frozen" plugs in glass stop-cocks.

227 **Stuart Oils.**—The second edition of this book, compiled by the D. A. Stuart Company, Chicago, Ill., includes much useful data on the kind of oil for use in different operations. The book is fully illustrated with tables and diagrams.

228 **Manganese Steel.**—The November issue of the Amsco Bulletin, issued by the American Manganese Steel Company, Chicago Heights, Ill., contains an interesting article on manganese steel sheaves as a means of saving rope as well as illustrations of manganese steel stone quarrying machine parts.

229 **Nirosta KA2 and KA4.**—The Associated Alloy Steel Company, Cleveland, Ohio, has printed three more pamphlets in their Technical Bulletin Series. These are: Resistance of Nirosta KA2 and KA4 against Chemical Attack, The Physical Properties of Nirosta KA2 and Fabrication of Nirosta.

230 **Westinghouse Catalog.**—The Westinghouse General Catalog, 1931–32, comprised of 1352 pages, presents descriptions and illustrations of apparatus manufactured and sold by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

231 **Pyrometers.**—Potentiometer pyrometers made by the Leeds & Northrup Company, Philadelphia, Pa., are accurate and well capable of withstanding rough service. They are described in a leaflet issued by the company.

232 **Refractories.**—A recent issue of *Grits & Grinds*, published by the Norton Company, Worcester, Mass., reprints an interesting article from Industrial Gas entitled "Alundum Refractories in Some Modern Gas Furnaces." A 16-page booklet issued by the company tells the whole story of the new Norton markings and "What is Controlled Structure?"

233 **Nickel Cast Iron.**—The December issue of this periodical published by the International Nickel Company, 67 Wall Street, New York, contains a brief history of cast iron, one of the series of Intimate Chats on Metallography and several important applications of nickel cast iron.

234 **Power Notes.**—The September-October number of this publication of the Diamond Power Specialty Corporation, Detroit, Mich., presents an interesting article on "Lowering Steam Consumption of Heating Systems," as well as one entitled "Superheated Steam Has Advantages in Drying Processes" and "Better Combustion with Clean Coal."

235 **Inspection.**—An attractive and well-planned booklet issued by the Pittsburgh Testing Laboratory, Pittsburgh, Pa., brings out the value of careful inspection of materials used in all construction.

236 **Small Power Motors.**—Circular 1883, a current publication of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., contains many illustrations showing construction details of their small power motors, their external appearance and some of their applications. Another publication of the same company is entitled "Cars and Car Equipment."

237 **Steel.**—A leaflet sent out by the Edgar Allen Steel Co., Inc., 741 Washington Street, New York, illustrates their "iron fibred steel" and lists a number of their other products.

238 **Welding.**—Several valuable articles on welding are found in the October issue of "The Welder." These are: Welding for the Chemical Industry, Electric Welding of Mild Steel by the Metal Arc Process and The Acetylene Welding of Copper. Published by Murex Welding Processes, Ltd., Ferry Lane Works, Forrest Road, London, England.

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Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS

These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

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GENERAL (0)

Value of Research in Non-Ferrous Metals. H. W. GILLETT. *Metal Industry* (London), Vol. 37, Aug. 8, 1930, pages 121–123.

Condensed from a paper read before the American Zinc Institute at St. Louis. Cites several recent expansions in research laboratory construction, due to the increased importance of scientific investigation. Research is insurance for tomorrow's profits. The Al business is built on finding, by research, the real facts as to their materials. The research department is the mainspring of the Al industry. Investigations on Mg have been in progress for several years, but progress is very slow. The International Nickel Co. ascribes its success in the last few years to the activities of its research department. Work of the Copper and Brass Association mentioned. Takes up the various uses of Zn and Zn alloys, and suggests further scientific research. VSP(0)

Tenth Report of the German Atomic Weight Commission. (X. Bericht der deutschen Atomgewichts-Kommission.) M. BODENSTEIN, O. HAHN, O. HÖNIGSCHMID & R. J. MEYER. *Berichte der deutschen Chemischen Gesellschaft*, Vol. 63, Jan. 8, 1930, pages 1–24.

Contains 70 references and gives a summary of investigations on atomic weights since Dec. 1928 on H, A, C, S, P, Cu, Hg, B, Pb, from Act., N, As, Sb, Cl, Re and Ni. Isotropes are discussed and revised tables of atomic weights and isotropes are given. CEM(0)

A Project of International Collaboration in Metallurgy. (Un projet de collaboration internationale en metallographie.) ALBERT PORTEVIN. *Revue de Metallurgie*, Vol. 27, Aug. 1930, pages 436–438.

During last autumn meeting of the Institute of Metals in Düsseldorf attention was called to the importance of bringing workers in different countries in contact with the latest developments of metallurgy. The question was resumed at the Spring Meeting of the Institute in London and the committee appointed at the former assemblage was able to formulate the optimum method for achieving it. Every country in which metallurgical work is being done shall appoint one or several persons of eminence in metallurgical work which once or twice a year will review the work of their country and communicate it to the international commission which will forward it to the societies of different countries for publication in their journals after translation. No new society or organization is proposed. The existing national societies are invited to nominate these members and communicate their names to provisional Commission of International Metallurgical Collaboration, Institute of Metals, 36 Victoria Street, London, S. W., England. The first meeting of the new commission is proposed for October at Düsseldorf. JDG(0)

Quality Steel Bar of Today Is Result of Long Period of Evolution. *Iron Age*, Vol. 126, Aug. 7, 1930, pages 325–348.

Traces developments which have kept steel makers busy to produce steel bars of dependable quality, to meet all requirements. Bessemer process wrought wonders in steel industry and greatly amplified uses of steel bars. Gives early classification of Bessemer steel for various uses. Railroads were the first to issue specifications and they varied as the engineers of each road differed in training and experience. Several grades of bars were determined by the amount of C they contained. Four factors affecting quality of steel are: method of manufacture, chemical composition, deformation process and heat treatment. Sound forging steel is made by open-hearth process with a scrap and pig Fe charge. Rolling processes have been improved in recent years. Exacting requirements of present day users leave much to be accomplished in future. VSP(0)

Some Trends in Science as Indicated by Accomplishments in 1929. H. E. HOWE. *Engineers & Engineering*, Vol. 47, Mar. 1930, pages 54–58.

A brief review of a series of industrial developments during 1929, among them the perfection of the high-Cr high-Ni alloy "Nirosta." (0)

The Increasingly Important Role of Chemistry in Steel Making. C. H. HERTY, JR. (U. S. Bureau of Mines). *Iron Age*, Vol. 126, Aug. 14, 1930, page 431.

From a report to the iron and steel section of the National Research Council's Science Advisory Committee. Major role of chemistry in steel making has been to formulate methods for determination of various substances in steel, once the effect of these substances has been determined by metallurgists. Scientific investigations on steel making may be divided into definite periods so far as type of work is concerned. Considers work that has been done from 1860 to 1930. VSP(0)

Steel Metallurgy in 1929. C. H. HERTY, JR. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 83–84; *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 181–182.

Among the important developments are the Aston process for the production of wrought iron and the increase in alloy steel applications. Much interest has been shown in nitrided steels. In the open-hearth furnace, greatest advances have been made in combustion control and in a better appreciation of the necessity of slag control. MS(0)

Interesting Uses of Barium and Beryllium. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Nov. 1930, page 811.

An editorial pointing out the economies available to industry through the application of high precision scientific work to industry. ESC(0)

Le Chatelier's Principle. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Oct. 1930, page 754.

An editorial. An argument in favor of fewer rules, regulations and restraints for technical metallurgists is presented as an encouragement for more genuine interest. ESC(0)

Eighteen and Eight. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Oct. 1930, pages 753–754.

An editorial. A survey of the austenitic metallurgy which is commercially culminated in the 18–8 chrome nickel steel is offered. The numerous desirable properties of this alloy are extolled and the furtherance of austenitic alloy development in the direction of the 18–8 chrome-manganese is indicated. ESC(0)

Quality Factors. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Nov. 1930, page 811.

An editorial pointing out the inaccuracy of any method of designating the quality of steel by numbers because of the multiplicity of variables involved. ESC(0)

Alloy Steels of Yesterday, Today and Tomorrow. EDWIN F. CONE. *Iron Age*, Vol. 126, Nov. 20, 1930, pages 1485–1487.

Alloy steels had their origin within the last 30 or more years. Cr and Ni play the major role in present-day alloy steels. Cr has been used as early as 1870. Gives an account of Julius Bauer's patented chromium steel in 1871. Origin of high-speed steel is credited to the work of Taylor and White. Birth of American alloy steel industry of today should be credited to the work of Rossi, de Chalms, Becket and others. Flannery, J. Kent Smith and others introduced Va and Mo. Electric melting in this country is credited to Moore, Snyder and others, although Stassano of Italy, Rodenhauser of Germany and Heroult of France are pioneers in electric melting development. Considers what scientific research has done in the development of ferrous and non-ferrous alloys. VSP(0)

A List of Alloys. WILLIAM CAMPBELL. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 1, 1930, pages 336–397.

Campbell's list of non-ferrous alloys, which has been so useful for reference, has been brought up to date, and greatly enlarged. There are about 8000 compositions listed. The physical properties of the standard and widely used alloys are given from American Society for Testing Materials specifications and from other sources. The utility of the list has thereby been vastly enhanced. It can be purchased separately from the bound volume of Proceedings. HWG(0)

PROPERTIES OF METALS (1)

Tantalum. FREDERICK GROVE-PALMER. *Sheet Metal Industries*, Vol. 4, Dec. 1930, pages 669–70.

The properties of the metal are set forth and possibilities of uses suggested, e. g., "diamond" drills, because of the hardness developed by the addition of a small percentage of carbon. AWM(1)

Vanadium and Its Applications. (Le vanadium et ses applications.) R. SEVON. *Journal du Four Electrique*, Vol. 39, Sept. 1930, pages 329–332.

Brief information regarding the ores, properties and application of V and its compounds. Taken largely from the literature of Vanadium Corporation. Description of their Bridgeville plant and laboratories is given. JDG(1)

The Metallic Character of Clean Platinum Contacts. (Eine Kontrolle des metallischen Charakters von Platinkontakten.) RAGNAR HOLM & RUDOLF STOERMER. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 9, No. 2, 1930, pages 323–330.

Experiments have been made to determine how platinum contacts behave under very high pressures. It can be concluded that clean contacts have a pure metallic conductivity at high pressures (to 1% exactly), and that Ohm's law holds good for current densities up to 4.3×10^6 amperes per cm.^{2} HA(1)

Measurement of the Thermal Conductivity of a Platinum Sample in the Temperature Range between 19 and 1020° C. (Messung der Wärmeleitfähigkeit einer Platinprobe im Temperaturgebiet 19–1020° C.) RAGNAR HOLM & RUDOLF STOERMER. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 9, No. 2, 1930, pages 312–322.

The specific resistance and the thermal conductivity of a 99.95% platinum sample was measured according to the method of Kohlrausch, Diesselhorst and Meissner and can be expressed, respectively, by the following equation:

$$c = 1.048 \times 10^{-5}[1 + 3.695 \times 10^{-3} (\vartheta - 15) - 5.98 \times 10^{-7} (\vartheta - 15)^2 + 5.25 \times 10^{-11} (\vartheta - 15)^3]$$

$$k = 0.699 [1 + 2.83 \times 10^{-4} (\vartheta - 19.5°)]$$

A table is given from which the errors of measurement can be taken. Ha(1)

A Method for the Determination of Thermal Conductivity of Metals, Especially at Elevated Temperatures. (Eine Methode zur Bestimmung der Wärmeleitfähigkeit von Metallen, besonders bei hohen Temperaturen.) RAGNAR HOLM. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 9, No. 2, 1930, pages 300–311.

In order to be able to use the method of Kohlrausch, Diesselhorst, and Meissner, also for very elevated temperatures the metal rod which is used in this test was modified so that the losses due to radiation could be neglected; the author therefore gave the sample a shape of 2 thick short cylinders which are connected by a very short, thin collar. The theoretical derivation for the method and an example showing the application for the computing of time for reaching final temperature is given, also 11 references. Ha(1)

The Electrode Potential of Indium Against Indium Chloride Solutions. SHIN'ICHIRO HAKOMORI. *Journal American Chemical Society*, Vol. 52, June 1930, pages 2372–2376.

The molal electrode potential at 25° C. of In(s), In^{+++} is given as + 0.336 volt referred to the molal hydrogen electrode. MEH(1)

The Temperature Dependence of Crystal Elasticity. II. (Ueber die Temperaturabhängigkeit der Kristallplastizität. II.) W. FAHRENHORST & E. SCHMID. *Zeitschrift für Physik*, Vol. 64, Sept. 22, 1930, pages 845–855.

It was previously found that the slip energy is independent of temperature and stretching velocity in the case of Cd crystals. The same result was obtained with single crystals of Zn (slip energy 0.97 cal./g.). Diagrams relating slip and slip tension are given for the temperature from —253° to 250° C. At higher temperature recrystallization disturbs these regularities. Below —83° rupture occurs by splitting along a basal face. (1)

Fundamentals of the Plasticity of Crystals and Investigation of Its Theoretical Interpretation. (Grundtatsachen der Kristallplastizität und Versuche zu ihrer theoretischen Deutung.) W. BOAS & E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 98–102.

General review of the situation as to the critical gliding stress and elastic limit of single crystals, chiefly based on experimental work of Polanyi and Schmid. The elastic limit found experimentally is only $^1/_{1000}$ to $^1/_{10000}$ of that calculated by present theory. A satisfactory theory must explain this, the law of critical gliding stress, why the gliding stress is so little affected by temperature, and why hardening occurs on the occurrence of slip. The theories of Voigt, Becker, Smeckal and Polyani are briefly mentioned. While there is to-day no general theory of crystal plasticity, this mysterious subject is so important to theoretical physics that it is to be hoped it will presently be cleared up. HWG(1)

Thirty-Sixth Annual Report of the Committee on Atomic Weights. Determinations Published during 1929. GREGORY PAUL BAXTER. *Journal American Chemical Society*, Vol. 52, March 1930, pages 857–862.

The only change in the atomic weight table given in this article is the lowering of As from 74.96 to 74.93. MEH(1)

The Selection of Tin for Fabrication. C. L. MANTELL. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 645–648.

Sb, As, Pb, Bi, Cu and Fe are the common impurities in commercial ingot tin which render it harder and grayer. Uniformity of properties desired is obtained by uniformity of metal. It is marketed in 2 classes determined by Sn content. These are the class A Standard Sn and the class B 99% Sn of a variety of brands which indicate the origin of the ore or the smelter and consequently the quality of merchandise. Gueterbock and Nicklin observed a lowering of the freezing point upon addition of traces of Pb, Cu, Zn, As and Fe, and a raising of the freezing point upon addition of Sb and S. Small additions of Cu and Pb softened the metal and greater quantities increased the hardness. Bi had the reverse effect. Sb, As, S, Fe and Zn increased the hardness. Data regarding hardness numbers, compression yield points, tensile tests, reduction of area are tabulated. The bend test is the most reliable guide, observations are included concerning the effect of various impurities. Comment is made upon bath losses through dross and the effect thereupon due to impurities. Coe observed that cylinders of Sn, Pb, and their alloys tested under compression of regularly increasing loads did not yield smooth curves when the changes in height and diameter were plotted in the form of load strain diagrams during the semi-plastic and plastic ranges but yielded discontinuities. This is termed critical plasticity and is characteristic of all metals. The observations on Sn are tabulated. Sn is white with a slightly bluish tinge. Thin films of the metal transmit brown light. The reflected light is whiter than Ag or Zn. The metal is decidedly crystalline. The crystals may be broken by cold working but are readily reformed by heating. ESC(1)

Heat Treatment, Ball-Hardness, and Allotropy of Lead. F. HARGREAVES. *Engineering*, Vol. 130, Sept. 26, 1930, page 389.

Abstract of paper read before the Institute of Metals, Southampton, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 897. LFM(1)

Gallium, Germanium, Indium, and Scandium. ALICE V. PETAR. *Information Circular* 6401, *United States Bureau of Mines*, Nov. 1930, 17 pages.

A description of these 4 metals is given under the following headings: properties, history, occurrence, ores, production, list of dealers, markets and prices, metallurgy. Over 100 footnote and bibliographic references are given. AHE(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Physical Properties of Electrically Conducting Wires at Low Temperatures. (Die Festigkeitseigenschaften von elektrischen Leitungsdrähten bei tiefen Temperaturen.) F. PESTER. *Zeitschrift für Metallkunde*, Vol. 22, Aug. 1930, pages 261–263.

Pulling and bending tests with wires of copper, bronze, pure aluminum, and Aldrey after varying storage times over the temperature range of —60° to +20° C. Tensile strength, elongation and bending value increase in general with decreasing temperatures down to —60° C. Changes in physical properties due to cold work during drawing are discussed. EF(2)

The Influence of Reheating upon the Resistivity and Resistance to Shearing of Alloys of Aluminum and Silicon. (Influence du revenu sur la résistivité et la résistance au cesaillement des alliages aluminium-silicium trempes.) LEON GUILLET & MARCEL BALLAY. *Comptes Rendus*, Vol. 190, June 23, 1930, pages 1473–1475.

The alloys used contained 0.4% of Fe and the Si varied between 0.14 and 2.56%. The resistivity of a wire previously heated for 30 min. at 500° and 600° C., reheated for varying times and temperatures, varied rather uniformly from 2.71 to 3.13 microhms/cm.^{3} 5 tables are given. The change in the resistance to shearing with different degrees of reheating, 150° and 200° C., when previously heated at 600° then at 500° is noted. (2)

Silver Solders. R. H. LEACH. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 493–511; *Metal Industry* (London), Vol. 37, Oct. 10, 1930, pages 337–340.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (2)

Some Non-Ferrous Engineering Alloys. WESLEY LAMBERT. *Metallurgia*, Vol. 3, Dec., 1930, pages 65–68.

Discusses bronzes and bearing metals. JLG(2)

Recovering Lead in Rubber Factory. F. L. HAUSHALTER (B. F. Goodrich Co.). *Chemical & Metallurgical Engineering*, Vol. 37, Feb. 1930, page 92.

The tensile strength of Pb, which is ordinarily 1900 lbs./in.^{2}, increased to about 2400 lbs./in.^{2} after it was melted and extruded onto wire and hose and removed therefrom. The percentage of elongation, however, decreased from about 50 to about 25. The tensile strength fell considerably below the original value at the temperature of vulcanization (280° F.). The tensile strength-temperature curve approximated a straight line. At 280° F., Pb began to yield at a stress of about 600 lbs./in.^{2} Dross Pb showed a straight line to the breaking point, less than 700 lbs./in.^{2} Refined dross yielded at 900 lbs./in.^{2}, while pure Pb began to yield at 700 lbs./in.^{2} The following table gives the tensile strengths in lbs./in.^{2} at the temperatures indicated:

	80° F.	280° F.
Pure lead, pig	1880	1239
Lead tube, before cure	1930	1345
Lead tube, after cure	2390	1385
Refined dross	1810	1118
Dross	400	650

MS(2)

The Copper-Tin Alloys. J. L. HAUGHTON. *Metallurgist*, Nov. 1929, pages 167–168.

A review of the work of W. Broniewski and B. Hackiewicz describing their own work, commencing with methods of preparation of samples for the study of electrical resistance, thermo-electric power, electrolytic potential, dilation and microstructure. (2)

Strength of Modern Aluminum Alloys Is Selection Factor. F. V. HARTMAN. *Machine Design*, Vol. 2, Apr. 1930, pages 22–26, 51.

A description of machine parts cast by various processes with an outline of advantages and tables giving average mechanical properties of Al sand casting alloys and factors applying to design stresses at elevated temperatures. (2)

The Significance of Hardness Values for Some Copper-Zinc Alloys. C. H. DAVIS & E. L. MUNSON. *Proceedings American Society Testing Materials*, Vol. 30, Pt. 2, 1930, pages 522–533.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. (2)

Specifications for Copper Alloy Ingots. G. H. CLAMER. *Metal Industry* (N. Y.), Vol. 28, Sept. 1930, page 433.

From a report read at annual meeting of the American Society for Testing Materials in Atlantic City, June 23–27, 1930. VSP(2)

Bearing Metals and Solders. J. BRADLEY. *Electrician*, Vol. 105, Nov. 28, 1930, pages 666–670.

The subject of bearing metals cannot be considered separately from that of lubrication. As the speed rises the friction of a journal decreases rapidly to a point depending on the pressure between the surfaces, and the viscosity of the oil, after which it increases slowly. There are periods, when starting from rest or stopping, in which the oil film does not exist making the metal of which the faces are composed important. A complete film of the lubricant is rarely maintained over a long period. A bearing metal should have as low a coefficient of friction as possible, regardless of the lubricant employed. The properties of efficient bearing metals, the alloys employed, and hard and soft solders are discussed. There is a wide gap between hard solders, requiring a red heat (700° C.) for fusion, and the soft solders of which there are none in general use now, other than the ordinary tin-lead solder with a melting point about 200° C. In addition, there is a similar gap in suitable fluxes, without which, of course, the solders are useless. Several photomicrographs and a melting point curve for Pb-Sn alloys are shown. WHB(2)

The Future of Silver and Its Alloys. W. GUERTLER. *Metal Industry* (London), Vol. 37, July 11, 1930, page 33.

Ag is not used pure, but usually contains alloying metals. German standard Ag contains not more than 20% of other metals, while American standard is $7^1/_2$%. Cu is the most common addition. The Cu alloys are known as "New Ag." Besides Cu they contain Ni, Fe, Zn, Cd, Sn, Al or Si. These new Ag alloys are often superior to Ag alloys in as much as they do not blacken. Another group of alloys is with Fe, at present superior to Ag alloy and known as "V_2A" steel. Ag may be used not as a principal constituent but as an addition to other metals. VSP(2)

P. M. G. Metal for Replacing the Bronzes. M. A. HUNTER. *Heat Treating & Forging*, Vol. 16, March 1930, pages 344–345.

Vickers-Armstrong, Ltd., has developed a Cu alloy substitute for Admiralty gun-metal, in which the 10% Sn of the gun-metal is replaced by 10% of a special hardener. The percentage of hardener may be varied. Alloy as cast contains 2% Fe and 3.4% Si with 2% Zn. Alloy is easily melted, and has a short freezing range of 50° C. It appears to be resistant to oxidation. Sand-cast alloy has an average yield-point of 25,000 lbs./in.^{2}, ultimate stress of 48,000 lbs./in.^{2} and elongation of 11.5% in 2 in. Metal can be readily forged hot. A bar forged at a red heat from a 3 in. round billet to a 1 in. square section had an average yield-point of 50,000 lbs./in.^{2}, ultimate stress of 77,000 lbs./in.^{2}, and elongation of 38% in 2 in. End forged at a black heat to 0.88 in. section had a yield-point of 82,650 lbs./in.^{2}, ultimate stress of 94,000 lbs./in.^{2} and elongation of 17% in 2 in. Brinell hardness of the sand-cast alloy was 104–121, forged, 126–143, and cold-finished, 149–153. Density is 8.45. MS(2)

PROPERTIES OF FERROUS ALLOYS (3)

Low-Expansion Nickel Steel. THOMAS F. RUSSELL. *Engineering*, Vol. 128, Sept. 27, 1929, pages 400–402.

Gives some results of tests carried out on Nilex, a steel containing 36% Ni. It is the Fe-Ni alloy having the lowest coefficient of expansion of all similar alloys under the same conditions of treatment. It was developed for use as clock pendulums, standard tapes for geodetic surveys, standards of length, and for scientific instruments where permanency of dimensions is important. Reviews theories of Guillaume and of Honda on magnetic induction and expansion of Fe-Ni alloys. Tests were carried out by the English Steel Corporation in an attempt to correlate coefficient of expansion, Brinell hardness, and magnetic induction. Includes tables and curves showing results of tests. LFM(3)

Nickel-Iron Alloys. H. J. GARNETT. *Electrician*, Vol. 104, Apr. 4, 1930, page 438.

The qualities of Mumetal are compared with those of Permalloy C particularly in relation to magnetic permeability, lessened susceptibility to impairment of magnetic properties by mechanical strain, and simplification of heat-treatment. WHB(3)

Chromium-Manganese Steels. F. M. BECKET. *Iron & Coal Trades Review*, Vol. 120, June 20, 1930, page 992.

Abstract of a paper, of the same title, presented at the recent meeting of the American Iron & Steel Institute in New York. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 900. RHP(3)

Nickel-Chromium Steels More Widely Used. E. C. KREUTZBERG. *Iron Trade Review*, Vol. 86, April 17, 1930, pages 45–49; April 24, 1930, pages 53–56.

Presents information on the composition, physical properties, heat and corrosion resistance, applications, processing and fabricating methods of Nirosta KA2 and its modifications. It is claimed that much of this is published for the first time. Average composition is: C, under 0.16%; Mn, under 0.50%; Si, over 0.50%; Cr, 17–20%; Ni, 7–10%; P and S, max. 0.025% each. A product with 3% Mo has been developed for the paper industry. On heating to 2100° F. and quenching in water, the KA2 alloy has a tensile strength of 85,000–95,000 lbs./in.^{2}; yield point 30,000–40,000 lbs./in.^{2}, elongation in 2 in., 55–60%; reduction in area, 70–75%; Brinell hardness, 135–145; Izod impact, 115–120 ft.-lbs.; Charpy impact, 100–110 ft.-lbs.; sp. gr., 7.86; heat conductivity, 0.052 g. cal./cc./sec./1° C.; sp. heat, 0.118; m. p., 2550° F.; sp. resistance, 73 microms at 68° F.; coefficient of linear expansion, 0.000020/1° C. from 0–1000° C.; modulus of elasticity, 27,000,000–30,000,000 lbs./in.^{2} It is resistant to attack by most commercial chemicals, air, gases, and water. The halogens and their acids dissolve the metal. To secure best results, it must be used in heat treated condition. Treatment consists in heating the alloy quickly to 2050°–2150° F., and cooling rapidly. It can then be worked, welded, machined, and formed. Cold-working hardens it. Gives details of the procedure to follow in forging, expanding, rolling, belling, flanging, bending, pickling, riveting, welding, soldering, brazing, shearing, punching, drilling, sawing, machining, threading, forming, drawing, spinning, grinding, and polishing. Tabulates the licenses of the Krupp Nirosta Co. MS(3)

Some **Effects of Nickel Content in Austenitic Iron-Chromium-Nickel Alloys.** NORMAN B. PILLING. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 278–290.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 900. (3)

Comparative Tests on Cast Iron (Essais comparatifs des Fontes, en Tchécoslovaquie). F. PISEK. (Ecole Polytechnique, Brno, Czechoslovakia.) *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 25–34.

Double shear tests on 15 mm. diameter bars, and to a lesser degree, Fremont shear tests (5.64 mm. diameter) show fair concordance with tensile tests. This conclusion is based on tests of 22 varieties of cast iron. Only the author's conclusions, without details of tests on different irons, are given. (3)

Cobalt Magnet Steels. H. E. KERSHAW. *Edgar Allen News*, Vol. 9, Sept. 1930, pages 701–705.

There are 2 classes of cobalt magnet steels: the low and medium cobalt chrome steels and the high cobalt steels. The cobalt chrome steels are subdivided: one containing 9% and the other 16% Co, but both containing 9–10% Cr, 1.5 Mo and 1.0–1.15% C; these are air-hardening and the best results follow a triple heat treatment. The high cobalt steel usually has 36% Co, with about 6% Cr, 4–6% W, and 0.9% C; these are oil-hardening; only a single treatment is necessary, but accurate temperature control is essential. This alloy has better magnetic properties than any other known at present; B-H max. values of 900,000–1,000,000 are regularly obtained. The high frequency electric crucible furnace is very efficient for the manufacture of cobalt magnet steels; can also be used for cast magnets. With Co-Cr steels better magnetic results are obtained from forged than from cast magnets; the higher the Co content, the greater the discrepancy between the magnetic results. With the 36% Co alloy, cast magnets can be produced having as good, sometimes better, magnetic properties than forged. Some special magnets are described. W(3)

Wrought Iron. H. W. GILLETT. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 25–30.

A correlated abstract. Considerable propaganda is obtainable regarding the corrosion resistant properties of wrought iron due to the presence of slag filaments or high purity of the metallic part of the aggregate. The former argument is considered highly questionable from a technical point of view. Ease of fabrication and the purely physical, rather than the chemical properties are of importance in many applications. It is readily welded, has good threading properties, and readily takes coatings such as galvanizing. Statements have also been made regarding the resistance of wrought iron to fatigue under vibration, to abrasion, as well as its ability to retain its strength at high temperatures. Moore has observed the endurance limits for the rotating beam and axial loading tests—plots are included—which indicate its superiority to *mild* steels. Sisco, Haigh, Moore and Kommer, Wright and Hinde, Howe, Rawdon and Epstein, Souther, Stanton and Barstow, Gough and Murphy and others are quoted as observing lower strength values for wrought iron. Repeated stress laboratory tests have not been borne out in practice as indicated by the use of alloy steel for car axles. Wrought iron has also been found highly satisfactory for car and locomotive piping. Various observations, notably Rawdon and Epstein and MacIntosh and Cockrell show that increase in phosphorus increases the endurance limit. Bernhard has conducted an interesting study of the "recovery" due to rest periods. Trinham, Haigh, and Tudsberry and Gibbs have made observations regarding "recoveries." Need for greater clarity regarding the ability of wrought iron to absorb energy and further data concerning the relation between rest periods and fatigue failure is pointed out. Izod values by Rawdon and Epstein, and Petrenko point to the utility of wrought iron as due to ability to resist impact rather than repeated stress. A balance should be struck between endurance limit and impact strength if we correctly appraise the service value of a material. It is notable that the makers of a material (wrought iron) advertised and advocated for both corrosion-resistance and fatigue-resistance have never published a single test on corrosion-fatigue. ESC(3)

Study of the Pearlitic Manganese Steels. JOHN H. HRUSKA. *Heat Treating & Forging*, Vol. 16, April 1930, pages 455–459; May 1930, pages 598–602; *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 802–806; Sept. 1930, pages 1463–1467.

Pearlitic Mn steels are of 3 types, viz., those containing 0.90–1.30%, 1.30–1.60% and 1.60–1.90% Mn. For carburizing steels, C content is 0.15–0.20%, while it is much higher for straight heat treating. Content of P is below 0.035%, and S is 0.100–0.125%. Examination for non-metallic inclusions, surface defects, seams, etc., is best conducted on annealed or normalized stock. Testing for quality in carburizing is based upon the McQuaid-Ehn test. The best index is obtained by counting the number of pearlite crystallites, completely surrounded by fine "veins" of cementite. Most desirable values range from 12×10^4 to 20×10^4. For specific purposes, concentration of C in the surface layers is considered essential. This concentration is nearly always above the eutectoid composition, providing the enriched case is more than 0.031 in. thick. Pearlitic Mn steels are mostly cleaner than other commercial grades of machine steels. Presents tables giving a comparision of the physical properties of pearlitic Mn steels with other alloy steels, and showing the effect of various heat treatments on the physical properties of the Mn steels. Following results serve as illustrations of the variation in properties with heat treatment. Steel in table contained 0.41% C and 1.69% Mn.

Treatment	Drawn at ° F.	Tensile Strength lbs./in.^{2}	Elastic Limit lbs./in.^{2}	Elongation % (2 in.)	Reduction of area %
As rolled		122,450	60,380	21.8	39.0
Quenched in	600	208,300	171,150	10.2	30.8
H_2O from	800	181,900	153,080	13.2	41.4
1475° and	1000	146,580	137,550	18.0	51.9
drawn	1200	114,130	88,850	21.3	57.3
Quenched in	600	167,900	139,000	9.4	36.3
oil from	800	149,180	111,280	13.6	40.0
1500° and	1000	127,330	90,460	20.4	51.3
drawn	1200	106,650	80,430	22.0	62.1

A steel containing 0.21% C and 1.69% Mn had a single impact value of 8.6 ft.-lbs. after quenching from 1650° F. in H_2O and drawing at 600° F. in salt for 2½ hrs. When the drawing temperature was increased to 1000° F., the impact value was 58.9 ft.-lbs. Shaft containing 0.34% C and 1.74% Mn, quenched in H_2O at 1450° F. and drawn at 800° F. had the following hardness numbers: Brinell, 396; Rockwell, C-42.3; Scleroscope, 58.8. When drawn at 1200° F. these were respectively, 26.9, C-28.8, 42.5. Mn improves the tensile properties of steel at higher temperatures. Steel containing 0.18% C and 1.44% Mn had a tensile strength of about 97,000 lbs./in.^{2} at 500° F. and 40,000 lbs./in.^{2} at 1100° F. Tests indicated that for grades containing 0.16–0.21% C, each 0.1% Mn above the amount ordinarily present in structural grades of steel corresponds to increases of 4.3–7.8% in tensile strength at temperatures around 500° F.; whereas at 1000° F., this improvement amounts to 4.8–10.6%. Pearlitic Mn steels are manufactured according to alloy steel practice in the basic open-hearth or electric furnace. Presents typical logs of heats. These steels have advantages in carburizing such as generally lower carburizing temperatures (1600°–1650° F.), 10–35% decrease in carburizing time, and decreased danger of deformation. In straight heat-treating, best results are obtained with grades containing not more than 0.55% C. Commercial grades are preferably quenched in H_2O instead of in oil. Tabulates possible ranges of quenching and drawing temperatures for various grades. These steels are being used in many industries, particularly those relating to transportation. Tabulates many of the applications. In mechanical operations their use results in an increase of 20–90% in feeds and speed. The life of tools is prolonged 35–400%. MS(3)

Gray Iron Possesses Valuable Engineering Properties. *Foundry*, Vol. 58, June 1, 1930, pages 152–154.

In high P gray Fe, physical properties depend on iron phosphide component. In low P the elasticity is dependent on properties and distribution of pearlite, ferrite and graphite. Modulus of elasticity for pure Fe and steels is close to 30,000,000 lbs./in.^{2} Tensile modulus of elasticity for malleable cast Fe is 25,000,000 lbs. Effect of overstrain in steel furnishes a comparison to the effect of primary strain in gray Fe. In higher C commercial Fe much of graphite occurs in whorls. Fracture proceeds through the graphite flakes. Localized stress intensities are higher than average stress intensities. VSP(3)

Production and Properties of Stainless Steels. (Die rostfreien Stähle, ihre Erzeugung und ihre Eigenschaften.) E. HOUDREMONT. *Stahl und Eisen*, Vol. 50, Oct. 30, 1930, pages 1517–1528.

The author classifies the stainless steels in 3 or 4 groups—martensitic, ferritic (semi-ferritic) and austenitic steels—and gives the production methods, the properties and the application of these various groups of steels. All stainless steels are mostly made in electric furnaces, in part in the open hearth furnace. The proper choice of the raw materials is of extreme importance. The various methods of making stainless steels in the open-hearth furnace are described in detail and charts of the charge of 2 heats are given. The casting properties of these various steels are discussed in detail, showing that the 3 groups behave differently in casting. The martensitic Cr and Cr-Ni steels with 13–15% Cr tend, when improperly deoxidized and with very low carbon content, to intercrystalline cracks. The truly ferritic 30% Cr and the semi-ferritic 18% Cr steels only tend to an orthotropic crystallization to a very small extent, and are not very sensitive to the cooling conditions. The austenitic Cr-Ni steels show a pronounced orthotropy. For rolling and forging all stainless steels must be thoroughly heated to 1100° C. The heat conductivity decreases from the martensitic to the austenitic steels, as given in the table below.

Carbon Steel	0.11 cal./° C. · cm. · sec.
Martensitic Steel	0.09 cal./° C. · cm. · sec.
Ferritic Steel	0.06 cal./° C. · cm. · sec.
Austenitic Steel	0.04 cal./° C. · cm. · sec.

Austenitic steels show the highest resistance to deformation in the group of stainless steels. The recrystallization temperature of austenitic steels is by 100–400° C. higher than that of the ferritic and martensitic steels, so that in using low rolling temperatures the austenitic steels can be strain hardened. In rolling stainless steels, a special design of the passes is necessary since these steels spread much more than other steels. The coefficients of spread are given for these steels, showing that the ferritic steels spread more than the martensitic and austenitic steels. All stainless steels can be cold-worked; austenitic steels can be strain hardened most. In deep drawing, the austenitic steels are unexcelled. Detailed information is given on the heat treatment of the stainless steels. Recrystallization diagrams have been established for the representative steels in all groups. As to the corrosion attack, reference is made to the recent publication by Strauss, Schottky and Hinnüber (*Zeitschrift für anorganische und allgemeine Chemie*, Vol. 188, Mar. 8, 1930, pages 309–324; *Metals & Alloys*, Vol. 1, Oct. 1930, pages 785–787). Difficulties in welding austenitic steels are discussed. Reference is made to development of stainless steels which are not impaired by welding. GN(3)

Comparison of the Physical Properties of Different Sections of Cast Iron and of the Standard Arbitration Test Bar. M. V. HEALEY. *Proceedings American Society for Testing Materials*, Vol. 30, 1930, part 1, pages 206–212.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Micro-Corrosion Tests on Aluminum and Aluminum-Alloys. (Mikrokorrosions-versuche an Aluminium und Aluminium-legierungen.) H. RÖHRIG. *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 362–364.

This paper delivered before the Deutsche Gesellschaft für Metallkunde, Berlin, 1930, presents evidence that the crystalline segregations are nobler than the surrounding matrix. Corrosion starts in the immediate vicinity of those segregated crystals. In the same manner the pure Al-plate on Al-alloys is attacked first, although Al turns out better if both layers are exposed to corrosive attack individually. The mechanism of the progressing corrosion is discussed as well as the influence of pores, pipes, inclusions and grain boundaries. By improving its purity, the crystalline segregations can be cut down materially and thus fewer weak spots are present. According to the author, the thermal treatment of Al and its alloys opens a wide, unexplored field with the object of improving the corrosion resistance. Röhrig kept track of the corrosion attack by means of a microscope. He used the following media: salt-water, with additions of hydrogen-peroxide, diluted organic acids and alkalies, formic acid, phenol diluted and pure. EF(4)

Corrosion-Prevention Methods as Applied in Aircraft Construction. H. S. RAWDON. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 61–67.

Discussion appended. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 901.(4)

Corrosion. (Korrosion.) Report of a Special Meeting of the Deutsche Gesellschaft für Metallkunde. PRZYGODE. *Elektrotechnische Zeitschrift*, Vol. 51, Sept. 4, 1930, pages 1278–1279.

Three principal questions were treated: (1) explanation of the corrosion phenomenon; (2) testing of metals for resistance to corrosion; (3) protection against corrosion by surface coatings. Recent investigations have proved that corrosion is an electro-chemical process, not a purely chemical one; phenomena, as forming of holes, de-zincing of brass, and formation of protective films on the surface prove this conclusively. This knowledge has led to several practical applications to make metals corrosion-proof by certain additions. Tests to determine resistance against corrosion should extend to determination of changes of surface, structure, and weight, and also those of mechanical properties. Measurements of tensile strength and particularly elongation have so far proved to be the most suitable, further bending tests and deepening tests. Certain test methods have been developed but none stand out as the best. With respect to sensitivity against influence of corrosion the properties can be taken in the following order: bending number, elongation, load, tensile strength, electrical resistance. Ha(4)

Rust-Proofing of Iron and Steel Products. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, March 1930, pages 215–218, 231.

Outlines the development of black rust-proof coatings such as the Bower-Barff, Parker, and Coslett and Richards processes. Then gives solution formulas and operating details for electrodeposition of Zn, and the production of black protective coatings over the electrodeposited Zn. MS(4)

The Resistance of Electrodeposits to Corrosion, with Special Reference to Cadmium and Zinc. W. S. PATTERSON. *Metal Industry* (London), Vol. 36, May 16, 1930, pages 527–529; May 30, 1930, pages 579–582.

Includes discussion. Paper before the Electroplaters' and Depositors' Technical Society, Apr. 30, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 902. VSP(4)

Corrosion of Riveting and Welding in Combustion Chemical Practice. (Die Korrosion an Niet- und Schweissstellen in der Brennstoffchemischen Technik.) O. GROSS. *Brennstoff-Chemie*, Vol. 11, Apr. 1, 1930, pages 133–134.

Responsibility of electrolytic action from acids and vapors reacting upon riveted and welded surfaces discussed. (4)

The Effect of Brines on Metals. (Die Einwirkung von Kühlsolen auf Metalle.) T. LIEPUS & H. OSTERBURG. *Metallwirtschaft*, Vol. 9, Nov. 7, 1930, pages 926–927 and Nov. 14, 1930, pages 946–948.

The action of chemically pure solutions of alkaline $CaCl_2$, neutral NaCl, alkaline NaCl and neutral $MgCl_2$ on Fe, Cu, Sn, Zn and Al is described, in regard to effect on the polish of the metals, their loss in weight and change of structure after metallographic examination. Curves showing loss in weight against time for 90-day immersions are given, grouped according to solutions and according to metals. Summarizing, these brines have the least effect on Sn. It is attacked slightly by the 2 alkaline solutions, but not by the others. Al is next best, then Zn. Fe is attacked the most, except by the 2 alkaline solutions. In choosing a brine the metals with which it comes in contact should be considered. Impurities in the solutions accelerate the attack on metals. Electrolytic action also takes place in the presence of 2 different metals. CEM(4)

Protective Coatings, Rust Protection and Coloring of Aluminum. (Ueberzüge, Rostschutz und Färbung des Aluminiums.) HERBERT KURREIN. *Metallwirtschaft*, Vol. 9, Dec. 5, 1930, page 1009; Dec. 12, 1930, pages 1031–1032.

Contains 9 references. Electroplating aluminum is more difficult than for other metals for several reasons. Al oxidizes very quickly when exposed to air. This oxide can be removed from pure Al by treating in HCl, HF or mixtures of the two, or in alkaline cleaners, such as Na_2CO_3–$NaHCO_3$ or NaCl–NaOH mixtures. Commercially impure Al and Al alloys cannot be cleaned in alkaline solutions as they leave a dark scum of insoluble impurities. These must be cleaned in acids. A slight etching is advantageous for plating, and for this reason sand blasting is practical. The high electrical potential of Al is another disadvantage and Al has a tendency to become covered with a loosely adhering coat of metal when immersed in the plating bath. This is best prevented by making Al passive previous to plating by dipping in concentrated HNO_3 at 60° C. for 5 minutes. This treatment also has the advantage of dissolving insoluble compounds after alkaline treatment. Al which has been made passive can be plated with Ni or Zn in acid solution, with Cd in cyanide and with Cu in H_2SO_4 or HNO_3 solution. Ag, Au, brass, or Cr can be plated over one of these metals. Ni is the best coating for Al. It can be applied without special previous treatment except degreasing in a special solution containing glycerin, at normal temperature with 0.5 amp./sq. dm., and 2–3 volts or at higher temperature with higher current density. In $^1/_2$ to 1 hour a dense, white coating of Ni is obtained which can be easily polished. Al can be Ni plated in ordinary solutions after making it passive in HNO_3, and dipping in weak alkaline cyanide and acid $FeCl_3$ solutions. Al cannot be plated with an adherent coating of Cu in cyanide solutions. A better process is to scratch-brush, dip in dilute alkali, then without rinsing in conc. HNO_3, plate in a solution of 100 g./l. $CuSO_4$ and 60 g./l. HNO_3 with 1–1.7 amps./sq. dm. at 1 volt for 10–20 minutes. For Zn plating Al should be sandblasted and after rinsing in water plated in 145 g./l. $ZnSO_4$, 35 g./l. sodium acetate and 1 g./l. gum Arabic. H_2SO_4 should be added to bring the pH to 4.0. Current density amps./sq. dm. This treatment gives very good corrosion resistance. CEM(4)

A Study of the Error of Averages and Its Application to Corrosion Tests. C. H. HUMES, R. F. PASSANO & ANSON HAYES. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 448–455

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 901. (4)

Accurate Corrosion Test for Chrome-Iron Alloys. W. R. HUEY (E. I. du Pont de Nemours Co.). *Iron Age*, Vol. 126, Dec. 4, 1930, pages 1696–1698.

From a paper read before the National Metal Congress. Describes test developed in the laboratories of the E. I. du Pont de Nemours Co. VSP(4)

Steel Mains and Corrosion. E. E. JEAVONS & H. T. PINNOCK. *Gas Journal*, Vol. 191, July 23, 1930, pages 203–204; July 30, 1930, pages 255–256.

Steel mains properly bitumen coated, laid and earthed according to the authors' method, are subject to little or no electrolytic corrosion. A brief résumé is given of the Mond high pressure distribution system. A study was made of the electrolytic corrosion in this system of mains. Specifications are given for preventing electrolytic corrosion. Joints should be Cu bonded and at regular intervals wrought Fe earth bars should be welded to main. (4)

Effect of Carburizing Mixtures on Nickel-Chromium Alloy. M. A. HUNTER (Driver-Harris Co.). *Fuels & Furnaces*, Vol. 8, April 1930, pages 553–554, 560.

Energizers most commonly used in carburization are Na_2CO_3, $CaCO_3$, and $BaCO_3$. Tests carried out by J. J. Vreeland on the corroding action of the carbonates on Nichrome, showed only slight attack at 950° C. by Na_2CO_3 and completely negative results with $BaCO_3$ and $CaCO_3$. Tests were then made on the effect of adding a small amount of free S to the carbonates, with the following results.

Material	Temp. ° C.	Time in hrs.	Weight of Ni-Cr alloys in grams Before	After
Na_2CO_3 + S	950	.75	18.1395	14.6698
$BaCO_3$ + S	950	.75	16.6424	16.2842
$CaCO_3$ + S	950	.75	15.4692	15.4057

Experiments were then carried out with 6 commercial carburizing mixtures some of which contained as energizers, only Na_2CO_3, others only $BaCO_3$, and others mixtures of these with $CaCO_3$. Small pieces of Ni-Cr alloy packed in these mixtures in a Ni-Cr container and subjected to 1000° C. for 24 hrs. showed no appreciable attack. The outside of the container was corroded considerably, however, particularly where Na_2CO_3 was used. This material is lighter and more easily carried out of the box as dust than the other carbonates, the same being true of the dissociation products, the oxides. It reacts with the S of the fuel gases, and the mixture containing the sulphide, depositing on the exterior of the box, exerts a corrosive action on the Ni-Cr alloy. Some observations indicated that Zn vapor is very destructive at high-temperatures to both Ni and Ni-Cr alloys. MS(4)

Occurrence and Estimation of Lead and Zinc Compounds in Coal. *Iron & Coal Trades Review*, Vol. 121, July 18, 1930, page 80.

Abstract of a paper read before the Institution of Mining Engineers at Birmingham, July 9 by K. Neville Moss, A. A. Hirst, and L. W. Needham on the above subject. Two methods of examination were used: (*a*) spectroscopical; and (*b*) chemical. 11 samples were tested The results are summarized in the following table·

Material	Percentage Content of Lead	Tin	Zinc
Coal A	0.0032	Nil.	Nil.
Dirt-parting	0.024	Nil.	0.048
Coal B	0.025	Nil.	Nil.

These metals can cause trouble by promoting corrosion of boiler tubes. RHP(4)

Treatment of Airplane Parts to Prevent Corrosion. DENIS O'BRIEN (Fairchild Airplane Corp.). *Metal Cleaning & Finishing*, Vol. 2, May 1930, pages 431–432, 444.

An oil is forced into metal parts made of hollow steel tubing and is allowed to drain. Frame tubes and struts are cleaned by sand-blasting, coated with an oil-base oxide primer, and then fixed in spar varnish. Axles of landing gear, hydraulic members and wing fittings are first Cd plated and are also painted. Al parts are scratch brushed on a buffing wheel and are then coated with full-bodied oil-based Fe_2O_3 which is oven baked for 2 hrs. Exterior parts are then lacquered. Pontoons are made of duralumin. A commercial cleaner is used on these. Then a mist coat of an oil-base, air-drying oxide primer is applied, after which 2 coats of lacquer are applied. Interior of pontoons is treated with a coating of some commercial glyceride. MS(4)

Preservation of Highly Polished Surfaces. A. C. HANSON (Rock Island Arsenal Laboratory). *Industrial & Engineering Chemistry*, Vol. 22, June 1930, pages 603–604.

Results of tests on the effect of humidity on polished surfaces show that high humidity does not necessarily mean corrosion. Unless the moisture is deposited on the metal, there will be no corrosion. It is a matter of dew point and not humidity. MEH(4)

Contribution to the Evans Theory. (Beitrag zur Evansschen Belüftungstheorie.) E. HERZOG & G. CHAUDRON. *Korrosion und Metallschutz*, Vol. 6, Aug. 1930, pages 171–172; **Contribution to the Evans Theory,** E. MAAS & E. LIEBREICH. *Korrosion und Metallschutz*, Vol. 6, Aug. 1930, pages 172–173; **Distribution of the Corrosion Occurring under a Drop (Ueber die Verteilung der unter Tropfen entstehenden Korrosion.)** U. R. EVANS. *Korrosion und Metallschutz*, Aug. 1930, pages 173–174.

See *Metals & Alloys*, Dec. 1930, page 903. Continuation of the controversy on the value of the drop corrosion test and Evans' interpretation. In the first publication, the French authors report on experiments which can be satisfactorily explained by Evans' theory. Maass and Liebreich point out that the deductions of the French investigators are wrong. Evans' article refers to a paper previously abstracted in *Metals & Alloys*. EF(4)

The Problem of Condenser Tube Corrosion. D. HANSON. *Nickel Bulletin*, Vol. 3, Mar. 1930, pages 81–85.

A theoretical consideration of corrosion, discussing particularly the mechanism of condenser tube corrosion, the theory of electrolytic corrosion and the factors influencing corrosion. It is concluded that the solution of the corrosion problem lies in the use of corrosion-resistant alloys. The possibility of the use of Ni-Cu alloys is treated. Contains a schematic illustration of a jet test apparatus used for determining the comparative corrosion resistance of various condenser tubes. (4)

The Influence of Soluble Fluorides on the Corrosion of Iron. A. W. CHAPMAN. *Journal Chemical Society*, Vol. 133, July 1930, pages 1546–1550.

The corrosion of Fe (as foil) by KF and KCl solutions (with and without the addition of the inhibitors Na_2CO_3 and $KCrO_4$) is studied. Corrosion occurs in the same manner in 0.7 *N* KF and KCl solutions, continuing for higher KCl concentrations, but for 0.85 *N* (and above) KF solutions, the action ceases abruptly. It is suggested that this behavior of KF solutions is due to the formation of a protective film (probably a fluoride or double fluoride of Fe) on the metallic surface which prevents attack. Much less concentrated Na_2CO_3 and $KCrO_4$ solutions are required to inhibit the attack of dilute KF solution than of KCl solution of corresponding dilution, probably because the fluoride ion penetrates the protective film produced by the inhibitors less easily than the chloride ion. Solutions 0.1 *N* in KF and containing 0.05*M*–0.005*M* $KCrO_4$ cause the appearance of black spots on the surface of the Fe specimen, explained as the result of the interaction between FeF_3 (a primary corrosion product) and the chromate in the solution. (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

A New Etching Reagent for Nitrided Layers. (Ein neues Aetzmittel für Nitrierschichten.) O. HENGSTENBERG & F. BORNFELD. *Krupp'sche Monatshefte*, Vol. 11, Sept.-Oct. 1930, pages 265–266.

Since the etching solutions for nitrides as proposed by Fry and Comstock do not satisfactorily show the transitions of the various nitrided layers in a nitrided steel, the authors developed a new method which applies the following solutions: 1 g. HgCl + 20 cc. HCl + 80 cc. alcohol. This etching follows an etching with a solution of 10 g. $MgCl_2$ + 1 g. $CuCl_2$ + 40 cc. HCl + 100 cc. alcohol. In testing the hardness of a nitrided steel, it is shown that the various zones developed by the etching correspond to the hardness-depth curve. GN(5a)

Constitution of Nickel-Chromium Alloys. N. B. PILLING & T. E. KIHLGREN. *Transactions American Society for Steel Treating*, Vol. XV, June 1929, pages 1060–1061.

The constitution of the nickel-chromium alloys is discussed by N. B. Pilling and T. E. Kihlgren, in a data sheet prepared for the American Society for Steel Treating. In spite of the great industrial importance of these alloys, the information regarding their constitution is conflicting and, in some cases, of debatable value. The authors present an equilibrium diagram which attempts to reconcile the conflicting data previously published. (5a)

Constitution of Nickel-Copper Alloys. N. B. PILLING & T. E. KIHLGREN. *Transactions American Society for Steel Treating*, Vol. XV, June 1929, pages 1061–1062.

A short summary of the information available on the constitution of the nickel-copper series has been prepared for inclusion in the data sheet series of the American Society for Steel Treating. Copper and nickel crystallize in a face-centered cubic lattice, and the alloys form a simple series, with complete miscibility of the 2 elements both in the liquid and solid states. The nickel-copper equilibrium diagram reproduced in the sheet is that of Guertler and Tammann, fully confirmed by later workers. (5a)

Grain Growth in the Chrome-Irons. ARTHUR PHILLIPS & RALPH W. BAKER. *Iron Age*, Vol. 126, Nov. 27, 1930, pages 1588–1589, 1665.

From a paper read before the National Metal Congress. Experiments with steel containing 28% Cr and 0.25% C leads to the conclusion that steel of this composition is subject to rapid grain growth at temperatures, 1290° to 1830° F. and rapid growth at temperatures 1830° to 2550° F. Coarse structure is the cause of brittleness. VSP(5a)

Secondary Hardening in "Hyper-Hardened" Steels and the Stability of Austenite. (Trempe secondaire des aciers hypertrempés et stabilite de l'austenite.) P. CHEVENARD & A. PORTEVIN. *Comptes Rendus*, Vol. 191, Sept. 29, 1930, pages 523–525.

If steel be quenched under conditions which result in the suppression of both Ar′ and Ar″ points it will be retained in the austenitic state. In other words, it will be "hyper-hardened" (hypertrempé). So then, if, starting with a hypereutectoid steel in a completely "hyper-hardened" state, one lowers its carbon content by any means, one should observe the appearance first of Ar″ and then of Ar′; further, the occurrence of austenite in a particularly stable condition should be observed between the Ar″ and Ar′ points. Chevenard and Portevin have been able to generalize these conclusions and to extend them to the case of secondary hardening observed in a steel containing 1.5% and 2.0% Cr, which had been retained in the austenitic state as a result of quenching in water from 1180° C. Subsequent to the above treatment suitable samples of this steel were heated to a series of constant temperatures for 7 hours, during which time they were subject to examination—dilatation, micrographic, hardness, electrical resistivity and magnetic tests being made. At drawing temperatures below 330° or above 500° C. the phenomena observed by the authors in the case of this steel were identical with those they had previously noted and described in respect to a "hyper-hardened" 2.0% Mn hypereutectoid steel. Between 330° and 500° C., however, a profound perturbation was noted in the case of the Cr steel which was clearly related to the appearance of phenomenon absolutely different from that of secondary hardening. It appears that during drawing the retained austenite becomes decarburized as a result of the precipitation of a complex carbide and concurrently a certain proportion of the austenite transforms to ferrite and iron carbide. This proportion at first decreases with the drawing temperature; at about 330° C., however, the proportion becomes practically equal to unity, while the resistivity attains a maximum and the hardness a first maximum. The proportion then falls with increasing drawing temperatures, as is evidenced by the trend of the dilatation isothermals. After drawing at temperatures between 330° and 500° C., there still remains a certain amount of partially decarburized austenite. Commencing at 350° C. this austenite transforms into martensite on cooling with consequent production of the Ar″ point. On elevating the drawing temperature the amount of Fe_3C liberated during heating rises and the remaining austenite is increasingly decarburized. As might be expected, the Ar″ point and the amplitude of the quenching transformation (Ar″ transformation) increase, the resistivity and hardness rising to a pronounced maximum. Finally beginning at 430° C., the Ar′ transformation appears with production of troostite—the phenomenon of the doubling of the Ar point, as seen in quenching, is then observed (a fact which the authors believe has not been described hitherto). The double maximum in the hardness curve for this steel establishes the existence of 2 modes of hardening: (1) structural hardening, due to the change from austenite to ferrite plus cementite; (2) physico-chemical hardening, due to the formation of secondary martensite. Finally, it has been proved that a region of temperature exists above the Ar″ point where partially decarburized austenite is relatively very stable. OWE(5a)

The Macro Etching of Tin-Base Bearing Metals. ERNEST B. DRAKE. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 20–24.

A method for macro-etching tin-base babbitts of various compositions has been suggested. The failures in connecting rod bearings which have been run in test engines appear most often in finely crystalline babbitts near the joint. The macro-etched babbitts indicate fairly well the size and distribution of the micro constituents which may be expected. Centrifugally cast main- and connecting-rod bearings show SnSb cubes are absent, all imbedded in a ground mass of tin-rich eutectic when the babbitt is of the type: 85% Sn, 7.5% Sb, 7.5% Cu. The die cast main- and connecting-rod bearings show no SnSb cubes but do show a larger amount of CuSn needles imbedded in a ground-mass of tin-rich eutectic and δ-solid solution when the babbitt is of the type: 85% Sn, 7.5% Sb, 7.5% Cu. ESC(5a)

The Photographing of Cooling Curves. H. D. CROCKFORD & A. E. HUGHES. *Journal of Physical Chemistry*, Vol. 34, Nov. 1930, pages 2624–2626.

Authors describe a simple apparatus developed by them for recording cooling curves of mixtures of certain nitrotoluenes and benzoic acid, the freezing points of which could be checked to 0.1° C. with those obtained from direct galvanometer readings. The apparatus could be readily applied to metallographic work. OWE(5a)

Automatic Preparation of Metallographic Samples. R. G. GUTHRIE & J. A. COMSTOCK. *Metals & Alloys*, Vol. 1, Sept. 1930, pages 727–730.

Fundamental considerations, operation of polishing machine, advantages of automatic preparation are discussed. (5a)

Iron-Aluminum-Carbon Alloys. (Beitrag zur Kenntnis der Eisen-Aluminium-Kohlenstoff-Legierungen.) O. VON KEIL & O. JUNGWIRTH. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 169–175; *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, page 1643.

The influence of Al on the systems iron–graphite and iron–cementite was studied. In melting Swedish soft Fe, the C was introduced by electrode graphite and technically pure Al was finally added. The results show that, for an Al content of 2–3%, practically all C is present as graphite. In increasing the amount of Al up to 11%, graphite disappears completely but, on further increase of the Al content to 18%, all C is again present as graphite. The eutectic temperature of Fe-C alloys is gradually increased with the increasing Al content so that this temperature amounts to 1300° C. for 14% Al. Above this content, the eutectic temperature is again lowered; 1% Al diminishes the eutectic C concentration by 0.16% C. The temperature of the pearlitic transformation is somewhat lowered up to 3.5% Al, but rises again above this concentration up to 8% Al. Detailed reference is made to the structures occurring in the alloys investigated. 2 new phases were observed in these alloys. GN(5a)

Coarse Crystallization of Aluminum. (Die Grosskristallisation von Aluminium.) R. KARNOP & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 94–98.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 906. (5a)

The Molecular Constitution of Certain Intermetallic Solid Solutions at Temperatures below that of the Eutectic Examined Thermodynamically. F. H. JEFFERY. *Transactions Faraday Society*, Vol. 26, Oct. 1930, page 587; **The Molecular Constitution of the Solid Solution of Tin in Lead at Temperatures Below the Eutectic.** F. H. JEFFERY, pages 588–590.

These two papers can be considered together. The former shows that the equation of equilibrium of the phases along the boundary from the end of the eutectic isothermal for decreasing temperatures is:

$$\log (1 - n') - \log n = \frac{\lambda}{R\Theta} + \left((\log K\theta_1 - \frac{\lambda}{R\Theta_1}\right)$$

where n = the molal fraction of Y in X for the first phase and n′ = the molal fraction of X in Y for the solid solution formed in the second two-phase system (the other symbols have their usual thermodynamic meanings). Now, if the molecular aggregations of the two components X and Y in each of the solid solutions be chosen suitably [log (1 — n′) — log n] is a linear function of $1/\theta$. Inasmuch as both solid solution boundaries are involved, it is almost certain that if a solution can be found it is unique. Hence, the molecular constitution of the solid solution at these temperatures can be found. The second paper shows that the above equation can be applied to the case of the solid solution of tin in lead from 180° to 130° C. and that, as a result, the assumption that an isothermal exists at 145° to 150° C. is untenable. OWE(5a)

What a Heat Treater Should Know about Physical Chemistry. GEORGE M. ENOS (University of Cincinnati). *Fuels & Furnaces*, Vol. 8, March 1930, pages 321–326.

Brief discussion of the gas laws, phase changes, and equilibrium diagrams. MS(5a)

A New Macroscopic Etching Reagent. *Metallurgist*, Sept. 1929, pages 142–143.

Brief review on the article by G. d'Huart in the June, 1929, issue of *Revue de Metallurgie* about the new etching reagent. See *Metals & Alloys*, Oct. 1929, page 179. (5a)

A Micro-Furnace for Temperatures above 1000°. H. S. ROBERTS & G. W. MOREY. *Review of Scientific Instruments*, Vol. 1, Oct. 1930, pages 576–580.

The furnace consists essentially of a bare strip of platinum-rhodium bent into a U and electrically heated. An optical pyrometer is sighted down into the bottom. Discussion of accuracy and limitations of the strip for investigations of phase relations and melting points at high temperatures. Advantages of this type of micro-furnace are: reaching very high temperatures, almost instantaneous heating and cooling, and light weight and consequent inexpensiveness of strip. Major sources of error are: differences of temperature between top and bottom of charge, and uncertainties in constancy of relation between brightness temperature and true temperature of strip. Upper temperature limit for single-thickness platinum-40% rhodium strip is about 1850° C. MFB(5a)

Structure & X-ray Analysis (5b)

An X-ray Analysis of the Copper-Manganese Alloys. (Röntgenanalyse der Kupfer-Manganlegierungen.) ELIS PERRSON. *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 9, July 1930, pages 25–42.

An X-ray crystallographic analysis of the Cu–Mn system is reported and the possibility discussed of a continuous transition of the Cu-phase into the γ-Mn-phase with increasing Mn content. It is shown that the γ-Mn-phase, ordinarily stable at high temperatures only, becomes stable at ordinary temperatures when alloyed with small amounts of Cu and chilled. The boundary of this phase occurs with concentrations of 83 atomic % Mn. The lattice parameter of the Cu-phase increases with increasing Mn content, from 3.008 to 3.74 A. U. with 50% Mn, then remains constant to the phase boundary. The atomic volume in both simply built phases appears to change continuously over the entire system. Alloys consisting of these phases are formed with considerable expansion. (5b)

X-ray Testing of Aircraft Materials. ANCEL ST. JOHN. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 147–149.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. (5b)

Measurements of Elasticity with X-Rays. (Elastizitätsmessungen mit Röntgenstrahlen.) G. SACHS & J. WEERTS. *Zeitschrift für Physik*, Vol. 64, Aug. 28, 1930, pages 344–358.

The change of the lattice constant of a "Duralumin" rod of oblong rectangular cross-section, on bending on the convex side is found to be proportional to the sagging. The ratio of the main dilatations is found from the spectrogram. Precision of the lattice constant is $\pm 3.10^{-4}$ A. U. (5b)

Application of Refraction of Electrons. (Ueber Anwendung der Elektronenbeugung.) E. RUPP. *Forschung und Technik*, 1930, pages 18–22.

For testing the structure of materials, X-rays have taken a dominant position when the space lattice is to be determined. For determining the surface structure and lattice, electrons are used with much greater advantage because of the smaller degree to which they penetrate into the material. Pictures can be made in a few seconds while exposures with X-rays require hours. The method uses electron velocities of 5000 volts and more. The tubes used and the practical application are described and some results of measurements of gas inclusions in metallic surfaces, chemical reactions of catalytic surfaces and glow-electrically and light-electrically acting surfaces. The results are illustrated by curves and diagrams. Ha(5b)

X-Rays in Engineering Practice. V. E. PULLIN (Research Department, Woolwich). *Engineer*, Vol. 150, Dec. 19, 1930, pages 686–688.

Abstract of paper read before the Institution of Mechanical Engineers, Dec. 1930. See also comment on pages 682–683. *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. LFM(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

A New Dead Weight Testing Machine of 100,000 lb. Capacity. L. B. TUCKERMAN, H. L. WHITTEMORE & S. L. PETRENKO. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 661–662.
A description of the design and use of a machine for calibration of horizontal testing machine. See *Metals & Alloys*, Vol. 1, May 1930, page 525. ESC(6)

Properties of Spring Steels on Tests. G. A. HANKINS & G. W. FORD. *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 205–210, 214.
Paper read before Iron & Steel Institute. MS(6)

Rail Steels at Elevated Temperatures. JOHN R. FREEMAN & G. W. QUICK (United States Bureau of Standards). *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 457–461.
From Technical Paper No. 269 of the American Institute of Mining and Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 565. MS(6)

Practical Experiences in Hardness Testing. B. BROWN. *American Machinist*, Vol. 73, Oct. 23, 1930, pages 651–654.
Discussion by C. H. Wilson, Wilson-Maeulen Co., Inc., *American Machinist*, Vol. 73, Oct. 30, 1930, page 693. There are 4 types of hardness testing machines: (1) Indentation, such as the standard Brinell, Brinell Comparator, Pyramid, Rockwell, Alfred Herbert and Hardometer; (2) rebound machines, such as Scleroscope, and the Alpha Rebondimeter; (3) ductility machines of the cupping variety, such as Erichsen, and the Erichsen-Olsen; (4) others, including Herbert Pendulum, and the cloudburst. Brinell was the first really successful machine. Measurement of depth of indentation is usually more accurate than the diameter. Cold weather gives increased oil viscosity and often erroneous results arise. Time of application of load and ball size often lead to errors. Etched balls make the microscope work more accurate. Brinell Comparator gives a rough estimate of hardness when used by an experienced man. It is of no value for thin sheet metal. Rockwell machine uses a different scale from that of the Brinell and causes confusion. It is not good for material less than 0.04 in. thick unless the material is very hard. The Pyramid tester appears to be the only indentation machine which may be used on very thin sheet. The Herbert machine is suited for rough work. It cannot well be used on hard metals. The Scleroscope is not good for any but flat surfaces and cannot be used on thin material. The Alpha Rebondimeter has about the same characteristics as the Scleroscope. Imperfections in the surface are more likely to throw the ball sideways. Erichsen is valuable where much press work is done. It gives 3 sources of information: (1) depth of cup; (2) dome macrostructure; (3) type of the burst. Does not measure force required for drawing. The Erichsen-Olsen machine is similar to the last but it measures force required for drawing also, up to 12,000 lbs. The Pendulum machine gives reliable results, readily convertible to Brinell scale. It also measures the potentialities of a metal for work hardening. The Cloudburst tests uniform hardness without damaging the surface. By reducing impacts so that the ball impressions do not overlap, the indentations may be measured and results converted to Brinell. Briefly gives principle and operation of each of the above mentioned machines. Discussion: Admits the confusion due to difference in Rockwell and Brinell scales. Discusses why the Rockwell machine could not use Brinell scale, and indicates that the Rockwell scale in actual practice is as accurate as the Brinell. Also that it has a place in testing which cannot be taken by the Brinell tester. RHP(6)

Practical Testing of Sheet and Strip for Drawing Operations. L. N. BROWN. *Metal Stampings*, Vol. 3, March 1930, pages 239–242, 270.
Cup tests are usually made to determine drawability of sheets. On material up to 0.0625 in. thick, standard practice is to use a $^7/_8$ in. ball or plunger with a 1 in. diameter die with standard radius, and standard width test piece. On heavier material most satisfactory results are obtained using the standard ball and a 2 in. die. A testing machine has been developed which measures the load necessary to make cups of certain depths, as well as the depth of cup. Samples 3 in. wide are used on tests of 0.0625 in. or under, while samples $4^1/_2$ in. wide are used for heavier sheets. In testing, the load necessary to make an impression 0.1 in. or 0.25 in. deep is measured, together with depth at which the sample breaks, and the thickness of the material. All tests should be made under the same conditions. Other tests such as the various hardness tests and the tensile test are also employed. Presents some typical results obtained. MS(6)

Hardness by Mutual Indentation. IRVING H. COWDREY. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 559–571.
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

The Relation between Sheet Thickness and Depth of Impression by the Erichsen Method. (Die Wirklichen Beziehungen zwischen der Blechdicke und Erichsentiefung.) K. DAEVES. *Stahl und Eisen*, Vol. 50, Oct. 23, 1930, page 1501.
Since the present known standard curves of the Erichsen method showing the relation between sheet thickness and depth of impression are unreliable, particularly for thin sheets, the author evaluated the results of 4000 tests to determine the true relations. As a result, it is shown that the depth of impression is not proportional to the thickness of the sheet but proportional to the logarithm of the sheet thickness according to the equation: depth of impression = 6.36 × log. sheet thickness ÷ 10.83 mm. GN(6)

The Wear of Rails. (Die Verformungsabnutzung der Schienen.) N. DAWIDENKOW. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1580–1584.
A new method to test the wear resistance of rails which determines the wear resistance by deformation tests is described. The diameter of a ball impression is chosen as the unit of the deformability. The ball pounds repeatedly against the surface of the rail under certain conditions. In comparing the results of this test on 109 rails, it is shown that the new method gives a reliable basis from which to predict the practical behavior of rails from laboratory tests as far as the resistance against deformation is concerned. GN(6)

Theory of Wear. (Ueber die Abnutzungtheorie.) H. FRIEDRICH. *Maschinenbau*, Vol. 9, Feb. 20, 1930, pages 129–131.
Comparison is made between abrasion by friction and by machines: grinding, filing, sawing, etc. The explanation for the wear theory is based upon these comparisons. Experiments are made on an abrasion-testing machine. Calculated and measured values are compared. (6)

Photo-Elastic Studies of Aircraft Parts. T. H. FROST. *Proceedings American Society Testing Materials*, Vol. 30, Pt. 2, 1930, pages 150–153.
Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846. (6)

A Furnace for High Temperature Tensile Tests. (Beschreibung eines Zerreissofens.) O. HOLTSCHMIDT. *Mitteilungen aus den Forschungsanstalten des G.-H.-H.-Konzerns*, Vol. 1, Nov. 1930, pages 40–44.
An electrically heated fused salt-bath furnace for tensile tests up to 700° C. is described, in which the specimen is immersed in the bath. Not over 6° C. difference in temperature exists between the middle and ends of the specimen. A Martens' mirror extensometer is used. The mirrors are removed before fracture of the specimen; the rest is left in the bath. Fittings are illustrated for use when testing tubing. HWG(6)

Offers Some New Hardness Tables. T. N. HOLDEN, JR. (E. W. Bliss Co.). *Iron Age*, Vol. 126, Oct. 2, 1930, page 932.
Describes 2 hardness tables. One of the tables deals with Brinell hardness using a 5 mm. ball with 750 and 250 kg. load. The other table shows Brinell hardness numbers using a 10 mm. ball with 3000, 1000, and 500 kg. load. VSP(6)

Army Arsenal Tests Experimental Welds. J. B. ROSE. *Welding*, Vol. 1, Oct. 1930, pages 832–834.
Results of experiments conducted at the U. S. A. arsenal at Watertown, Mass. on fatigue and impact values for welds. 6 tables summarize the data. W(6)

Proper Heat Treatment Reduces Stress-Corrosion Cracking of Brasses. ALAN MORRIS. *Fuels & Furnaces*, Vol. 8, July 1930, pages 935–936, 946.
From paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, Apr. 1930, page 473. MS(6)

Inspecting Bar Stock by Magnetic Analysis. R. R. MOORE. *Machinery* (N. Y.), Vol. 36, May 1930, pages 672–673.
A brief description of etching test and functioning of magnetic flaw detector. Oscillogram for bar containing crack is shown; approximate size of crack is indicated diagrammatically. A summary of advantages is given. See *Metals & Alloys*, Vol. 1, July 1930, page 629. (6)

Creep Stress Determination. *Metallurgist*, Feb. 1930, pages 22–23.
A review of the work of W. Rohn on the correct determination of the limiting creep stress of materials working for long periods at high temperatures. Among the materials considered: Alloy of 16% Fe, 60% Ni, 15% Cr, 7% Mo and 2% Mn, annealed at 1050°. (6)

The Unbalanced Alternating Current Bridge for Magnetic Analysis. W. B. KOUWENHOVEN & A. C. SELETZKY. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 298–312.
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

The Effect of Under-Stressing on Cast Iron & Open-Hearth Iron. J. B. KOMMERS. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 368–383.
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

Influence of the Specimen Shape on the Notch Toughness of Sheets of Various Composition and Heat Treatment. (Einfluss der Probenform auf die Kerbzähigkeit von Grobblechen verschiedener Zusammensetzung und Wärmebehandlung.) F. KÖRBER & K. WALLMANN. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, pages 193–202, Report 157; *Stahl und Eisen*, Vol. 50, Dec. 4, 1930, page 1724.
The authors investigated the suitability of various notch bar specimens in order to determine the influence of the shape on the data of heat treated sheets. Four different structural steels were used for the investigation. Sheets in 3 thicknesses, between 10 and 30 mm., were rolled at 3 different temperatures between 700° and 900° C., annealed partly above and partly below the A_3 point, either cooled in the furnace or on the floor. Other samples were quenched and drawn, and tested. GN(6)

Mechanical Testing of Aircraft Materials. J. B. JOHNSON. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 119–126.
Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846 (6)

Fracture of Notched Tensile Tests. (Der Bruch Gekerbter Zugproben.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 7–16.
See *Metals & Alloys*, Vol. 1, Sept. 1929, page 118. (6)

Internal Stresses in Hollow Cylinders of Tool Steel Estimated. O. V. GREENE (Carpenter Steel Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1378–1380.
Taken from a paper read before the American Society for Steel Treating. Describes 2 methods of determining internal stresses in hollow cylinders of carbon tool steel. Relative advantages are pointed out. VSP(6)

Fatigue Strength and Resistance to Slip. (Schwingungsfestigkeit und Gleitwiderstand.) P. LUDWIK. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 374–378.
Fatigue tests were performed paralleling tensile and hardness tests in order to throw light upon the correlation of endurance properties with elastic limit, maximum tensile strength, reduction of area and hardness. Hardness measurements during the fatigue test were carried out and yielded an increase of 65% in case of electrolytic copper, presumably the metal was stressed to the same degree as given by the fatigue strength value. At lower or higher stresses, this maximum hardness could not be attained. Further endurance tests refer to polished and notched test rods of various materials and some experiments were carried out with sea-water dropping upon the test pieces in order to study the corrosion endurance strength. Endurance bending and torsion tests with polished test rods yielded a ratio between torsion and bending strength of 0.575 ± 6%. The same ratio holds for the yield point values from torsion and tension (compression) stress in the case of static load. A larger ratio of 0.929 ± 6.16 was obtained on cast iron due to the notching effect of graphite. In spite of equal degrees of grooving the sensitiveness to torsion amounted to only 0.575 of the bending value. Owing to this the torsion fatigue strength of turned or notched test bars compared with their bending endurance strength is higher than in test pieces with a polished surface. EF(6)

The Danger of Fracture in Metallic Materials. (Die Bruchgefahr bei metallischen Werkstoffen.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 14, 1930, pages 60–61. Also in *V. d. I. Nachrichten*, Vol. 9, No. 49, 1929.
Further comment on the importance of "technical cohesion strength" (Trennfestigkeit). Very general discussion. (6)

Calculation of Vibration Strength from Tensile Strength and Elastic Property. (Berechnung der Schwingungsfestigkeit aus Zugfestigkeit und Trennfestigkeit.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 82–85.
See *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. (6)

Problems in Technical Cohesion. (Fragen der technischen Kohäsion.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, pages 85–91.
See *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. (6)

Critical Notched Impact Values. (Kristische Kerbzähigkeitswerte.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 44–58.
See *Metals & Alloys*, Vol. 1, Mar. 1930, page 427. (6)

Magnetic Testing of Steels. (Die magnetische Prüfung von Stählen.) KUEHNEL & PUSCH. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 12, 1930, page 1521.
More recent methods use, instead of direct current, alternating current and an oscillograph for both indicating and recording. In this way, defects, heat treatment, hardness, inclusions, segregations, etc. can be determined as well as the quality of welded seams. The instrument is built by the Magnetic Analysis Corp., Long Island City, N. Y. A few records are given. Ha(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Cadmium as an Electroplated Coating. (Kadmium als galvanischer Ueberzug.) HERBERT KURREIN. *Chemiker Zeitung*, Vol. 54, April 30, 1930, pages 333–335.

Contains 17 references. A review and discussion of the development of Cd plating. CEM(7a)

Artistic Finishes on Floor Lamps and Lighting Fixtures. MEYER ROTOR. *Metal Stampings*, Vol. 2, Jan. 1930, pages 39–40, 52; Feb. 1930, pages 139–140, 170.

Solution formulae and operating details for imparting to brass and bronze parts such finishes as acid bronze, English bronze, antique English bronze, Flemish bronze, Flemish brass, and oxidized silver. MS(7a)

Electrodeposition of Uncommon Metals. D. B. KEYES & S. SWANN, JR. (University of Illinois). *Metal Cleaning & Finishing*, Vol. 2, May 1930, pages 415–416.

Abstract of a bulletin of the University of Illinois Engineering Experiment Station. See *Metals & Alloys*, Vol. 1, July 1930, page 630. MS(7a)

Control of Copper Cyanide. WALTER M. PINNER & EDWIN M. BAKER. *Metal Cleaning & Finishing*, Vol. 2, June 1930, pages 511–512.

Abstract of paper read before American Electrochemical Society, May 29–31, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 797. MS(7a)

Use of Insulated Racks for Electroplating. *Metal Cleaning & Finishing*, Vol. 2, June 1930, pages 497–498.

A recent development in racks for suspending parts in the plating tank is one having the spine coated with a special corrosion-resisting compound which insulates it from contact with the electric current. Its use effects savings of metal, labor, and current. MS(7a)

Lead Anodes for Chromium Plating. L. C. PAN (College of the City of N. Y.). *Metal Cleaning & Finishing*, Vol. 2, May 1925, pages 405–408; June 1925, pages 503–506.

Pb has been found to be a superior material for insoluble anodes for Cr plating, and is most generally used. Steel is the only other material being used in any appreciable quantity. Advantages of Pb are that it does not seriously affect the metal content of the bath; if proper care is taken, it is insoluble in CrO_3 and has long life; it admits no impurities to the bath; and it maintains a low trivalent Cr content in the bath. Pb anodes have a high O over-voltage due to the fact that a film of PbO_2 forms over the entire surface as soon as they are put into operation. This film reoxidizes the trivalent Cr back to the hexavalent form, thus maintaining the proper composition of the bath. If Pb anodes are left in the bath when not operating, $PbCrO_4$ will be formed on the surface which will shorten the life of the anode and will necessitate the use of higher voltages. Proper care of the anodes requires that the current be turned on the anodes immediately after putting new ones in the bath; and every day, as soon as the day's plating is done, they should be removed from the bath, rinsed in H_2O, wiped off with a soft brush or sponge, and allowed to dry in air over night. After more than 6 weeks time, it is not necessary to clean the anodes every day. Anodes made of 6% Sb and 94% Pb differ from pure Pb anodes in that they are less soluble in Cr plating solutions, form less $PbCrO_4$ while idle in solution, form less PbO_2 while in operation, are harder, and have more strength. Simplest way to connect anode body to the anode bars is to attach a Pb-coated Cu hook to the anode body by means of bolts and nuts. Anodes are best made in narrow strips 4 in. wide, $^3/_{16}$ in. thick, and long enough to reach 4–6 in. from the bottom of the tank, and should be arranged so that there will be a space of 3–4 in. between adjacent anodes. Each hook should give contact on the anode bar at 2 points. Anode current density should be lower than the cathode current density. MS(7a)

Production of Imitation Pewter and Flemish Iron Finish on Brass and Copper Parts. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, April 1930, pages 307–309.

Describes cleaning, plating, and polishing operations, and gives solution formulae. MS(7a)

Electrodeposition of Tin. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, Feb. 1930, pages 117–120, 136.

Operating details and solution formulae for coating metal articles by the boiling process and by electrodeposition. Outlines uses and applications of Sn as a protective coating. MS(7a)

Electroplaters' Handbook. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 71–74; Feb. 1930, pages 167–170; March 1930, pages 257–260; April 1930, pages 347–350; May 1930, pages 441–444; June 1930, pages 541–543; July 1930, pages 633–637; Aug.1930, pages 717–720; Sept. 1930, pages 805–808; Oct. 1930, pages 887–890.

Collection of receipts and formulae, with operating details, for the deposition of Al, Sb, As, brass, bronze, Cu, Cd, Co, Cr, Au, Fe, Pb, Ni, Pd, Pt, rust-proof deposits for Fe and steel, Au, Sn, and Zn; various colors and finishes on metals; pickling; silvering glass mirrors; and dips and matts. MS(7a)

Preparation and Chemical Control of Brass Plating Solutions. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 25–30.

Gives typical plating bath formulae and operating details. Deals with anode composition and reducing agents. Outlines method of chemical analysis. MS(7a)

Electrodeposition of Nickel for Chromium Plating. SAMUEL GORDON. *Metal Cleaning & Finishing*, Vol. 2, April 1930, page 310.

To prevent peeling of Ni deposit even though imperfectly cleaned the following solution is recommended: 1 gal. H_2O, 6 oz. $NiSO_4$, 2 oz. $NiSO_4$-$(NH_4)_2SO_4$, 1 oz. $NiCl_2$, 1 oz. $MgSO_4$, 1 oz. H_3BO_3, $^1/_2$ oz. Ni F_2. Cast brass or bronze articles should be flash plated in $Cu(CN)_2$ solution prior to Ni plating. Bath must be kept up to full working capacity by periodical additions of 1 oz. $NiSO_4$, $^1/_2$ oz. $NiCl_2$ and $^1/_{16}$ oz. NiF_2/gal. of solution. MS(7a)

The Electro-Deposition of Cobalt-Nickel Alloys. Part I. S. GLASSTONE & J. C. SPEAKMAN. *Transactions Faraday Society*, Vol. 26, Oct. 1930, pages 565–574.

The compositions of the alloys deposited from well-buffered solutions of definite H-ion concentration containing various proportions of cobalt and nickel sulphates have been studied at a series of current densities ranging from 0.0028 to 5–6 amp./sq. dm. At low current densities the compositions of the deposits are almost independent of (1) the current density; (2) the dilution of the solution; and (3) stirring. Beyond a certain current density the Co content of the deposits decreases; the deposits always contain relatively more Co than do the electrolytes. The former phenomenon has been correlated with the impoverishment of the catholyte in cobalt ions, occasioned by the latter phenomenon. Dilution of the electrolyte emphasizes the former phenomenon; stirring tends to eliminate it. The composition of the initially deposited alloys is independent of the H-ion concentration of the electrolyte; the current efficiency for metal deposition increases with increasing pH and the effect of impoverishment of the electrolyte appears at lower current densities. Acetate ions do not appear to affect the relative tendencies for Co and Ni to deposit from solutions of mixed suphates. The paper concludes with a comparison of Co-Ni with Fe-Ni depositions. OWE(7a)

Platinum Plating for Repaired Weights. *Metal Industry* (N. Y.), Vol. 28, Aug. 1930, page 380.

From Technical News Bulletin of the Bureau of Standards. VSP(7a)

Silver Plating Small Brass Articles by Immersion. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, May 1930, pages 411–412.

Describes procedure employed, including operating details and solution formulae for cleaning, acid and cyanide dipping, Ag immersion, and final cleaning and lacquering. MS(7a)

Variation in Thickness of Nickel Deposits. LELAND E. & VERNON E. GRANT (New Departure Mfg. Co.). *Metal Industry* (N. Y.), Vol. 28, June 1930, pages 275–276; July 1930, pages 325–327.

Gives results of experiments to determine variation in thickness of Ni deposit on articles plated in various parts of one tank. Also how much the pieces in one tank varied from those in other tanks. Plating solution was of following composition:

Single nickel salts	16 oz./gal.
Ammonium chloride	2 oz./gal.
Boric acid	2 oz./gal.

Three types of anodes used. These were cast, electrolytic and heat treated rolled anodes. Attempt was made to hold pH between 5.6 and 6.1. Current density was about 5 amps./ft.^{2} Thickness of deposit was measured, first, through a microscope and, secondly, by weighing amount of deposited Ni. Contains table giving results of measurements of 64 specimens. Another table gives results of measurement made on specimens plated in a double salt solution of the following composition:

Double nickel salt	10 oz./gal.
Ammonium chloride	2 oz./gal.
Boric acid	2 oz./gal.
Epsom salts	2 oz./gal.

As a result of experiments, the following conclusions are justified: (1) similar articles plated simultaneously in single Ni salt solution do not have uniform deposits; (2) pieces at the bottom of the rack usually have the thickest deposit. VSP(7a)

Preliminary Study of the Electro-Deposition of Metals from Liquid Ammonia Solutions of Their Salts. L. F. AUDRIETH & L. F. YNTEMA. *Journal of Physical Chemistry*, Vol. 34, Sept. 1930, pages 1903–1906.

As a result of experiments involving the electrolysis of cyanides, iodides and nitrates of a number of metals, the authors conclude that the phenomena of electro-deposition of metals from liquid ammonia solutions of their salts closely parallels the behavior of the corresponding aqueous solutions. They question whether the use of liquid ammonia as a solvent will lead to the desposition of metals which have not yet been discharged from aqueous solution. OWE(7a)

The Production of Continuous and Seamless Tubing by Electrodeposition. JEAN BILLITER. *Metal Industry* (N. Y.), Vol. 28, Aug. 1930 pages, 378–380.

Paper presented before the Electrochemical Society at St. Louis, May 29–31, 1930. Describes 2 methods of making Cu and Fe tubing. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 796. MS(7a)

Electro-Deposition of Metallic Beryllium. HAROLD SIMMONS BOOTH & G. G. TORREY. *Journal American Chemical Society*, Vol. 52, June 1930, pages 2581–2582.

Communication to the Editor. The authors announce that they have been successful in obtaining Be by the electrolysis of solution of Be salts in various inorganic and organic non-aqueous solvents. The metal so deposited is insoluble in the strongest acids unless the metal is in contact with a more electro-negative metal like Pt. Dehydrated Be salts may be electrolyzed in liquid ammonia and the metal obtained. MEH(7a)

Airtight Joints by Electroplating. J. B. CALVA (Baeder Adamson Co.), *Chemical & Metallurgical Engineering*, Vol. 37, July 1930, page 445.

A cast-iron waste-heat evaporator, in which the tubes were electrically welded to the headers, would not hold a vacuum, as the welds were not airtight. Fe rings $^1/_4$ in. in diameter were placed around each of the welds, concentric with the tubes. Small pieces of rubber held the rings in place and insulated them. The rings were interconnected with Cu wire, and a piece of wire passed through a watertight wooden cover which was bolted to the flange. An electrolyte made up of $FeCl_2$, $CaCl_2$, and H_2O was poured into the tubes, covering the rings and welds. The electric welding machine was adapted for electrolytic work, the current being limited to 15–20 amp./dcm.^{2} The positive terminal was connected to the Cu wire from the rings and the negative, to the evaporator. After 24 hrs. of electrodeposition, the maximum expected vacuum was obtained. MS(7a)

Effect of Addition Agents on Acid Copper Plating Solutions. B. CLARK & E. O. JONES. *Metal Cleaning & Finishing*, Vol. 2, March 1930, page 232; April 1930, pages 319–320.

Paper presented before Electroplaters' and Depositors' Technical Society and the Faraday Society. See *Metals & Alloys*, Vol. 1, July 1930, page 630. MS(7a)

Burnishing and Nickel Plating Kitchen Utensils. T. C. EICHSTAEDT. *Metal Industry* (N. Y.), Vol. 28, Oct. 1930, page 478.

Discusses the burnishing and plating of steel articles such as spoons, egg separators, beaters, turners, strainers, ladles, etc. Deals with ball burnishing of stainless steel. Gives solutions for burnishing and barrel plating. VSP(7a)

Electrometallurgy (7b)

Electrolytic Recovery of Lead from Lead Sulfate Waste. COLIN G. FINK & LAWRENCE GREENSPAN. *Canadian Mining Journal*, Vol. 51, Oct. 10, 1930, pages 974–976.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. (7b)

Manganese in Electrolytic Zinc Practice. OLIVER C. RALSTON (United Verde Copper Co.). *Engineering & Mining Journal*, Vol. 130, Oct. 23, 1930, pages 375–378; Nov. 24, 1930, pages 510–512.

An analysis of available data and a critical study of the evidence that formed a considerable part of the testimony in the case of Electrolytic Zinc Process vs. French's Complex Ore Reduction, hinging on the validity of a Canadian patent. WHB(7b)

Investigation of the Influence of Current Density and Temperature upon Commercial Zinc Electrolysis. (Untersuchungen über den Einfluss von Stromdichte und Temperatur auf die technische Zinkelectrolyse.) P. RÖNTGEN. *Metall und Erz*, Vol. 26, Dec. 1929, pages 617–624; correction, Vol. 27, Jan. 1930, page 34.

Contains 2 references. The influence of current density and composition of acid Zn solutions on the H overvoltage are discussed. Higher current density can be used only with higher Zn concentration and this is limited by the solubility of Zn in dilute H_2SO_4. The influence of current density and temperature on current efficiency, voltage and current requirements in pure solutions was investigated and is illustrated by curves. The harmful effect of Co is less pronounced with higher current densities. While formerly 320–450 amps./m.^{2} was the usual current density, 6000 amps./m.^{2} is desirable at 60–80° C., especially when Co is present. The lowering of current efficiency when colloids are used to obtain smoother deposits is less at higher temperatures. CEM(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Applying Aluminum in Petroleum Refinery. STANLEY GILL (Gulf Pipe Line Co.). *Chemical & Metallurgical Engineering*, Vol. 37, Aug. 1930, page 483.

Based on paper read before the American Petroleum Institute, Dec. 5, 1929. Al and its alloys are very resistant to H_2S corrosion at temperatures below 250° F. Since the development of numerous fields producing high S crudes, use of Al in the refinery has increased greatly. Solid Al roofs for tanks designed like the usual steel roof are too costly. Light-gage Al has proved valuable as a sheathing over wooden decks of tanks. In some cases where corrosion is extremely severe, it is possible that the cost of solid Al decks will be justified by the savings. Main applications of Al and its alloys will be confined to small pieces of equipment which are not subjected to extremely high temperatures or pressures, but which are rapidly corroded. MS(8)

Aluminum Foil Coatings Cut Evaporation Losses. STANLEY GILL (Gulf Pipe Line Co.). *Chemical & Metallurgical Engineering*, Vol. 37, Aug. 1930, pages 508–509.

From paper read before the American Petroleum Institute, Dec. 1929. Progress report of investigation, still incomplete, on use of Al foil as a coating material for oil tanks. Most difficult feature is the discovery of a suitable adhesive, few having been found. Foil 0.0015–0.005 in. thick has been used successfully. If it is less than 0.003 in. it is likely to be too light. It is very easily applied, if a suitable adhesive has been selected. Foil coatings applied with adhesives that were not oilproof showed a life against severe sulphide corrosion more than twice that of the best paint coatings. Exterior coatings are more resistant to corrosion and afford much better protection against evaporation losses than Al paint. A tank with only the deck foil coated has about half the evaporation rate of a tank entirely coated with Al paint. MS(8)

Large Galvanizing Bath Made of Three Heavy Plates, Welded Together. *Iron Age*, Vol. 126, July 24, 1930, pages 229, 248.

A tank believed to be largest ever produced, was made by Thompson Brothers at Bradley Engineering Works, Bilston, England. Plates are of $1^1/_2$ in. gage for bottom plate and 2 in. for the 2 verticals, each of which made a side and an end. Internal length of bath is 36 ft., width inside 3 ft. 3 in. and depth of 5 ft. 6 in. Weight of each side of plate is 8 tons. Weight of completed tank is 24 tons empty. Its capacity is 130 tons of spelter. Joint welded by the Smith Fire process. Composition of bath material is given. Compares American steel for same purpose. VSP(8)

Deposition of Cadmium on Small Iron and Steel Articles by Immersion. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, June 1930, pages 491–493.

Articles must be just as clean as they should be for electroplating. An ideal surface is one that has been sand-blasted, immersed in an acid dip immediately thereafter, and washed in cold H_2O. Fabricated steel articles should be cleaned with a solution of 3 oz. KOH and 3 oz. Na_3PO_4 per gallon, H_2O at 180–200° F., washed, given an acid dip, washed, and given an alkaline dip. The articles are then immersed in the Cd solution consisting of 1 gal. H_2O, 8 oz. KOH, 3 oz. CdO, 2 oz. Na_2SnO_3, 4 oz. $Al_2(SO_4)_3$ (commercial) and $^1/_{10}$ oz. 1 min. Postum. The solution is heated to the boiling point and maintained at this temperature in a wooden or enameled steel tank. A minimum of 30 minutes immersion is required to obtain a Cd deposit that will meet an exposed weather test or a 20 hr. salt-spray test. Malleable iron articles immersed 45 min. in the boiling solution and exposed to a weather test in New York did not show any indication of rusting until the end of 60 days. To increase the life of the rust-resisting qualities of the coating the articles should be immersed for a moment in a solution of pt. China wood oil and 3 pts. CCl_4 and C_2HCl_3, measured by volume. MS(8)

Temperature of Galvanizing Bath Affects Dross Production. WALLACE G. IMHOFF. *Iron Trade Review*, Vol. 86, June 19, 1930, pages 65–66.

Important practical features affecting the character of the dross made are: the size and shape of the galvanizing pot, method of heating the pot, heat distribution, temperature of metal bath, method of drossing the pot, and the drossing equipment. High degree of heat in the bottom of kettle makes dross denser, and causes pot to fail somewhere at dross line. Average normal operating temperature for large amount of material is 850° F. Holes in drossing spoon should be of the proper size. The higher the temperature of the bath, the greater is the dross production, the higher is the Fe content in the dross, and the greater is the specific gravity of the dross. Includes photomicrographs of dross with various percentages of Fe. MS(8)

Bend Tests on Hot-Dipped Zinc Coatings Measured with Micrometer Calipers. WALLACE G. IMHOFF. *American Metal Market*, Vol. 37, Dec. 24, 1930, pages 5, 9, 10.

The complete results of tests on galvanized iron pails are tabulated and lead to the conclusion that the lighter the Zn coating and the lower the temperature of the bath, the better the adherence to the base metal, the less peeling and flaking, and the more ductile the coating. For procuring the best coating, a good grade of zinc must be used, and the proportion of alloys added to the bath is kept at a minimum. The time "through the flux" and the "submersion time" give a combined time of 24 seconds in the metal. Best results (pails from plant Z) were due to: (1) an open steel base; (2) proper picking conditions; (3) good condition of the Zn pot; (4) proper fluxing conditions; (5) the right use of metal additions to the bath; (6) the right bath temperature; (7) the proper submersion time; (8) the proper withdrawal time; (9) the right production for the conditions set; and (10) the lightest weight of metal deposited. A similar number of reasons for the poor deposits (pails from plant S) are given. Thirteen general conclusions are listed and a comparison of the deposits on pails from 4 sources tabulated. WHB(8)

Smoothness of Zinc Coatings. WALLACE G. IMHOFF. *Heat Treating & Forging*, Vol. 16, June 1930, pages 729–731; *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1154–1156.

To obtain a smooth Zn coating, steel should have low P and S, be free of segregation, contain very little oxides and inclusions, have an unoxidized surface, and be poured at the proper temperature. The surface of the steel should be smooth, i. e., contain no rolled-in scale and be free from corrosion and rust. Steel should be properly pickled. After pickling, it should be well fluxed with a hot clean liquid flux which will dry quickly and leave the surface a steel gray color. The flux on the kettle must be kept fresh and glossy, and it should roll onto the work, rather than part. The temperature of the galvanizing bath must be correct. Metal additions must be in the proper amounts. Too much Al and Ag in the bath will make a rough coating. If kettle is not drossed often enough, coating will be very rough. Overheating the bath will also cause a rough coating. Scruf and oxides in the coating are due to wrong temperature and wrong composition of the bath. Too fast withdrawal will give a rough finish. Articles done one at a time have a high quality finish. A number of articles galvanized at one time tend to stick to each other and tear the coating. For smooth coatings, work should be put into the H_2O tank before the coating becomes sticky. The H_2O should be hot for small articles. It can be colder for larger work. MS(8)

INDUSTRIAL USES AND APPLICATIONS (9)

Arc Welding Used for Large Gas Line. *Chemical & Metallurgical Engineering*, Vol. 37, March 1930, page 154.

Uinta Pipe Line Company's arc-welded line from southeast of Rock Springs, Wyo., to Ogden and Salt Lake City, Utah, comprises 200 miles of 18-in. pipe and 77 miles of 16-in. pipe. Each joint in the section is welded twice, 2 separate beads being run around each joint. The first bead is welded with $^3/_{16}$ in. electrodes, about $^3/_4$ lb. of electrode metal being used for the 18-in. joints. The second bead is welded with $^1/_4$ in. electrodes, about $1^3/_4$ lb. being consumed. MS(9)

Heat-Treated Steel Rails. *Iron & Coal Trades Review*, Vol. 121, July 25, 1930, page 126.

Abstract of Report No. 2 at the 11th session of the International Railway Congress Association by M. Cambournac and M. Patte on "Resistance of Rails to Breakage and Wear." Report pertains to all countries except the British Empire, America, Japan, and China. Based on statements from 60 companies who answered the questionnaire sent out by the association. Question No. 6 was: "Have you carried out tests with heat-treated rails? What results have you obtained? Describe the treatment and give its principal characteristics. Explain the test method which has enabled you to satisfy yourself that the treatment has been done properly. In what position and under what condition do you prefer to use heat treated rails?" Describes treatment by the Sandberg process, Newves-Maisons process, and the Maximalianhütte process. The French Joint Committee on rails draws conclusions in favor of heat treatment. French railways have extended the use of heat treated rails. Gives a method of testing to determine whether heat treatment has been properly done. RHP(9)

Aviation Materials—Reviewed in Broad Symposium. *Iron Age*, Vol. 126, July 3, 1930, pages 19–22.

Conducted by the American Society for Testing Materials at Atlantic City, June 27, 1930. Chairman Knerr read a brief introduction on the scope of the aircraft industry. Metals in aircraft construction were discussed by J. B. Johnson in a paper, "Ferrous Metals used in Airplane Construction." R. L. Templin, F. V. Hartman and E. C. Hartman read a paper, "Structural and Engineering Light Alloys for Aircraft." Papers dealing with aircraft engines were, "Failures of Aircraft Engine Parts and Causes Thereof," by Thomas T. Neill and "Materials of Construction in Aircraft Engines," by R. R. Moore. Abstracts of these papers will be found in *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. Jerome Strauss read a paper on "The Highly Alloyed Steel in Aircraft Construction," which is also abstracted in the November issue of *Metals & Alloys* on page 842. Welding as applied to aircraft construction was taken up in papers by H. L. Whittemore, J. J. Crowe and H. H. Moss on "Procedure Control in Aircraft Welding," and T. Watson Downes on "Metal Joints in Aircraft Construction." These are abstracted in the October, 1930 issues of *Metals & Alloys* on page 801. The concluding paper of the symposium was by Horace C. Knerr on "Heat Treatment of Aircraft Parts." An abstract of this is on page 849 of the November 1930 issue of *Metals & Alloys*. VSP(9)

The Uses of Nickel Brasses. SHERWOOD B. SEELEY. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 657–659.

A discussion of the nickel brasses (nickel silver) whose compositions are 60% Cu, 5.30% Ni and the remainder Zn, also those containing small amounts of Pb. The color of these brasses varies directly according to the amount of Ni present. The 18% Ni is silvery white and the 5% Ni is very light colored brass. It is used for ornamental vases and cups and tableware. In these uses the alloys are readily Ag plated. These articles do not bend as readily as sterling Ag. Low priced watches are made of this alloy since wearing of nickel plate disclosed no yellow brass. Rustless equipment in bathrooms, cafes, boats and automobiles are also made from this material. Nickel brass can be drawn and stamped into trays, dish-holders, milking machine parts, etc. It is drawn into wire for mesh bags. A popular patented slip fastener is manufactured from these alloys. Seamless tubing may also be drawn in all sizes from these alloys. Nickel brasses are made to contain 1% Pb. This alloy does not rust, is easily machined, and may be rolled very hard. They are used for keys and rods in automatic screw machines. The rolling treatment of these alloys is similar to ordinary brasses. They may be spun and extruded. The 60% Cu alloy shows a transformation point called fire-cracking. ESC(9)

How Castings Meet Designers' Needs in Modern Machinery. D. M AVEY. *Machine Design*, Vol. 1, Sept. 1929, pages 26–30.

A description of various phases of application of castings to machine construction from the standpoint of the designer. The physical properties of castings are listed. States the properties of gray cast Fe and their value to the machine designer, malleable cast Fe characteristics, as well as those of steel castings and non-ferrous castings. (9)

Belgian Rails: Conditions of Service and Control of Quality. *Iron & Coal Trades Review*, Vol. 121, July 25, 1930, page 117.

Abstract of a paper of this title presented by Jules Servais at the Liege Congress of Mining and Metallurgy. Increased weight, speed, and traffic require better rails. Rails are made of basic Bessemer steel. Tensile strength 68 to 70 kg./mm.^{2} Average carbon 0.45%, maximum 0.55%. RHP(9)

Steel House Construction. *Iron & Coal Trades Review*, Vol. 121, July 11, 1930, page 48.

Abstract of paper read by Lee H. Miller before the American Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. RHP(9)

Metallurgical Progress and Its Influence in Ship Building. (Metallurgische Fortchritte und ihr Einfluss auf den Schiffbau.) C. COMMENTZ. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 22, 1930, pages 1613–1614.

In ship building and construction of marine engines, improvements have been made in the years since the war which are due to a very great extent to improvements in production and working of metals. The question of material in ship building hinges on 3 points: strength, weight and price. Greater strength, as it is found in recent materials, results in reduced weight but is always more expensive. But in marine shipping increased cost of ships can, to a certain extent, be admitted because the loading capacity is increased by reduced weight and, therefore, the pay load is increased. A better economy, especially in engines, can also be obtained. From these points of view, the author discusses the advantages of using high-grade steels for the body of the ship whereby the differences between passenger liners and freight steamers are taken into consideration. The influence of high-grade steel in engines and boilers and the use of light metals are also considered. These last are not yet commonly applied because of their cost, except in warships, large trans-Atlantic passenger liners and small, fast ships. But there seems no doubt that these materials will, in the future, be used in this field to a much greater extent as the shape (flow lines) is essentially influenced by metallurgical progress. Ha(9)

The New Diesel Aircraft Engine. FAY LEONE FAUROTE. *Iron Age*, Vol. 126, July 17, 1930, pages 148–151, 201–202.

Diesel aircraft engine developed by Packard Motor Co. weighs 2.26 lbs./hp., with a maximum speed of 2000 r.p.m. developing 225 hp. at 1950 r.p.m. Operation of diesel engine. Crankcase weighs 34 lbs. and is made of alloy steel. Combination of fuel pump and nozzle are detachable. Pistons are made of Al alloy and the crankcase is made of one piece Mg alloy casting. Domestic fuel oil is used. VSP(9)

HEAT TREATMENT (10)

Heat Treatment of Aircraft Parts. HORACE C. KNERR. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 154–170. Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (10)

Heat Treating Aircraft Materials. J. W. URQUHART. *Heat Treating & Forging*, Vol. 16, June 1930, pages 743–746.

Describes English practice. Wire is subjected to a straight-line heat treatment process. Electric resistance heating is slowly displacing gas and oil-fired tubular furnaces. Material used for spar building strip intended for heat treatment is a rolled 40–45 ton steel, containing 3–5% Ni and 0.5–1.5% Cr. Heat treatment raises the tensile strength to 80–90 ton/in.^{2} Vertical heat treating system is used for wing strip steel. Strip is made part of an electric circuit. For thicknesses varying from 0.01–0.02 in., actual voltage used is 5.5–9 volts per ft. length of strip. Steel is heated until temperature is 1472–1562° F., which it attains in 15 sec. Current is allowed to flow for almost a minute, when it is diminished until the temperature is about 1336° F. Heated strip is protected from oxidation by carrying it through the heating and cooling phases in a narrow tube of refractory material, filled with a reducing atmosphere. Strip is quenched by drawing it through a chamber filled with ordinary machining suds. It is then extended upon a tempering bench, provided with means of applying considerable mechanical tension upon it, while the steel is being heated to a maximum of 788° F. This eliminates distortions and tempers the steel at the same time. This process is carried out electrically, using 20–40 volts and 100–350 amperes, depending upon the cross-section and width of the strip. Time taken is less than 2 min. MS(10)

Heat Treatment of Cylinder and Alloy Irons. F. J. WALLS & A. HARTWELL, JR. *Fuels & Furnaces*, Vol. 8, July 1930, pages 969–971.

From a paper read before the American Foundrymen's Association. MS(10)

Character of Furnace Equipment Used in Heat Treatment of Aircraft Parts. HORACE C. KNERR. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1103–1105.

From a paper read before the American Society for Testing Materials. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. MS(10)

Heat Treatment of Automotive Parts. ERNEST F. DAVIS (Warner Gear Co.). *Fuels & Furnaces*, Vol. 8, May 1930, pages 617–622; June 1930, pages 791–794.

Describes furnaces used and practice followed in annealing, cyaniding, carburizing, and hardening of various automotive parts. MS(10)

Heat Treating in a Modern Forge Shop. M. J. GORMAN (Moore Drop Forging Co.). *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 41–42.

Usual practice is to normalize, reheat, and quench in oil, water, or caustic solution. Forgings are drawn at 900–1350° F., depending upon physical properties desired. Tabulates properties of SAE 3130 steel after various treatments. Dies to be hardened are placed face down in a furnace having a temperature of 600–800° F., and heated slowly to 1400–1475° F., if made of straight C steel, or to 1450–1550° F., if of alloy steel. The former are water quenched, while the latter are oil quenched. MS(10)

Correct Design and Heat Treatment of Steel Dies for Die Castings. R. L. JOHNSON (Garwood Works, United States Aluminum Co.). *Iron Age*, Vol. 12, Aug. 28, 1930, pages 546–548, 576.

Based on address before joint meeting of the Canton and Cleveland chapters of the American Society for Steel Treating. Proper design of dies can only be attained by experience, designing skill and the application of specialized knowledge. Die casting die steels fail owing to surface checking. Checks are due to fatigue of surface layer in contact with molten metal. Preliminary checking may be due to presence of inclusions in the steel. Die cannot be kept at uniform temperature throughout its mass. Actual life of a die depends on the shape, design and function of the casting. Complicated dies seem to give the best service. Hardening of dies is difficult. One piece dies are more satisfactory. Modern trend is toward use of higher alloy die steels for Al. Dies for Zn-base die castings are made of machine grade of steel, with added chromium. Proper soaking period is important. Furnaces for proper heat treating should be of such type that all parts of furnace are at the same temperature at all times. VSP(10)

Continuous Equipment for Heat-Treating Steel Castings. A. C. JONES (Lebanon Steel Foundry). *Fuels & Furnaces*, Vol. 8, April 1930, pages 475–478.

Two continuous, oil-fired, pusher type furnaces are used. The castings are heated to 1650° F., quenched in air, and drawn at 1225° F. After this treatment, medium C steel has a pearlitic structure. Typical physical properties obtained with different heat treatments of steel with 0.25% C are:

	Yield-point lbs./in.^{2}	Tensile strength lbs./in.^{2}	% elongation	% reduction of area
Annealed	39,500	69,500	28.2	36.2
Normalized	44,500	75,585	27.3	38.0
Normalized and Drawn	42,415	70,417	30.0	46.8

MS(10)

Trend in Heat Treatment of Alloy Steel Castings. A. W. LORENZ (Bucyrus-Erie Co.). *Iron Age*, Vol. 126, Sept. 11, 1930, pages 693–695, 755–756.

Manufacture and treatment of alloy castings is one of the most important developments in the steel founding industry. During past 2 years there was a rapid increase in the use of full-quenching treatments. Car-bottom annealing furnaces are still preferred. Three classes of alloy steel castings have been developed—pearlitic, manganese, nickel chromium and air-hardening chromium-nickel molybdenum. VSP(10)

Hardening (10a)

Tool Hardening Today. A. H. D'ARCAMBAL (Pratt and Whitney Co.). *American Machinist*, Vol. 73, Sept. 18, 1930, pages 472–475.

Over 90% of tool steel made in this country is made by the electric furnace process. It is better quality than that made by the crucible process due largely to closer control. Lists and gives composition of 5 of the more common steels used for tools. Largely a description of methods of treatment used by the Pratt and Whitney Co. RHP(10a)

The Mechanism of Hardening Steel. (Ueber den Mechanismus der Stahlhärtung.) G. KURDYUMOV & G. SACHS. *Zeitschrift für Physik*, Vol. 64, Aug. 28, 1930, pages 325–343.

Austenite (γ-iron) chilled from 1100° to room temperature is partially converted into a tetragonal modification, as shown by X-ray diagrams (Debye-Scherrer) from a rotating rod of the material. The dark ground of the films points to considerable irregularities in the arrangement of the atoms of the crystal lattice. Tempering leads to formation of martensite. The lattice distortion diminishes with increasing temperature and time of tempering. The relative orientation of the crystals of the austenite modification, the tetragonal phase and the γ-iron has been found and the possible course of the rearrangement is discussed. (10a)

Case Hardening & Nitrogen Hardening (10c)

Thermal Analysis of Quenched Carbon Steels. SEIKICHI SATO. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1095–1096.

From a paper published in Science Reports of the Tohoku Imperial University. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 800. MS(10c)

Relation of Time and Temperature to Depth of Case in Carburizing of Carbon Steels. J. SORENSON. *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 41–43.

Proposes the use of the equation $A = K \times b$ for determining the depth of case obtained in 1 hr. of carburizing time at a definite temperature for straight C steels. A = hrs., K = a constant which varies with carburizing temperatures. The constants for various temperatures are: 1600° F. 0.0045; 1650° 0.0060; 1700° 0.0080; 1750° 0.0110; 1800° 0.0130; 1850° 0.0155. The equation may be used for determining the time required to obtain a desired depth at a definite temperature. The constants are merely to be used as a guide in determining the depth that can be obtained under average conditions. Although based on results obtained from actual experience, various factors may cause variations. MS(10c)

Case Hardening with Nitrogen. C. F. OLMSTEAD (Mahr Mfg. Co.). *Heat Treating & Forging*, Vol. 16, April 1930, pages 509–511.

Includes bibliography of 9 references. General, non-technical review of the nitriding process, advantages of nitriding, and the steels suitable for nitriding. MS(10c)

The Case-Hardening of Commercial Steels by Means of Nitrogen. B. JONES. *Iron & Steel Industry*, Vol. 3, Dec. 4, 1930, page 77.

The specimens (3/4" square) were nitrided 90 hours in silica tube 3' length of 3 1/2" diameter. The steels studied included 5 austenitic and 20 plain C and alloy steels. The austenitic steels were of the following types: 18–8 Cr-Ni, invar., 15–5 Ni-Mn, 26.5–13.4–3.5 Ni-Cr-W, and 1.25–13.2 C-Mn. The C contents of the plain C steels were 0.04, 0.30, 0.60, and 0.90%. The alloy steels included 4 and 5% Ni, two Ni-Cr, Ni-Cr-Mo, 2 Cr-Al-Mo, 2 Ni-V, Ni-Cr-V, 2 Cr-V, 2, 13, and 29% Cr and a 2% Al. Dry NH_3 gave greater hardness and better appearing cases. Nitriding temperatures of 600 and 650 showed a tendency to embrittle the case. Austenitic steels, in which the austenite was stable at the nitriding temperature, were not appreciably hardened. The 1.25–13.2 C-Mn transformed and showed increased hardness due to the transformation and to some nitriding. The plain C steels show the following % increase in hardness: 82, 88, 44, and 8 for 0.03, 0.30, 0.60, and 0.90% C, respectively. Of the alloy steels the Cr-Al-Mo steels showed the best results. Next in order came stainless steel, 1.2 Cr-0.7 V, 1.2 Cr-0.4V, and 2.0 Al. The 4 and 5% Ni steels showed no hardening. The author studied the duplex treatment of calorizing and nitriding. Calorizing before nitriding improved the nitriding properties of the steels in the following decreasing order: 4 Ni, 2.7 Ni-0.4 V, 5 Ni, 0.60 C, 0.30 C. Calorizing was harmful to Cr-Al-Mo, invar and Ni-Cr-W steels. The bibliography contains 25 references, very few American. OEH(10c)

Nitriding of Steel in European Practice. J. W. URQUHART. *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 48–50, 52.

Nitralloy concerns recommend that steels for nitriding contain from 0.9–1.3% Al. Normal depth of the case is 0.02 in. which is generally obtained by heating at about 500° C. for 90–100 hrs. All other treatments should be completed, and the surfaces should be thoroughly cleaned before nitriding. Boxes of 18% Cr-Ni steel are used in British practice. The ordinary nichrome ribbon resistor furnace is used in all European countries. Wire basketing is often used to hold the work. Flow of NH_3 is regulated to give a dissociation of 25–30%. Hardness of case is comparable to that of bort. MS(10c)

Quenching (10d)

Selection of Heat-Treating Oils. ARTHUR MUMPER. *Heat Treating & Forging*, Vol. 16, April 1930, pages 460–461.

Proper quenching oil for oil-hardening non-shrinkable steels is determined by the nature of the pieces to be treated. Consideration should be given to the difference in specific gravity of oils. Light oils conduct heat more rapidly than heavy oils. Therefore, the former are more suitable for heavy sections of steel, while the latter are better for thin sections. Illustrates the point by describing the quenching of a high Mn steel die ring and a W steel die plate, both of which were quenched at 1500° F. and drawn at 385° F. MS(10d)

Single Quenching after Carburizing. WILLIAM F. CHUBB. *Heat Treating & Forging*, Vol. 16, April 1930, pages 481–483.

Reprinted from *Metallurgia*, Vol. 1, March 1930, pages 197–199. MS(10d)

Aging (10f)

The Age-Hardening Process in Alloys (Separation of Supersaturated β Copper-Zinc Solid Solution on Aging at Different Temperatures). (Zur Kenntnis des Vergütungsvorganges in Legierungen. (Der Vorgang der Entmischung übersättigter β(Cu-Zn)-Mischkristalle durch Alterung bei verschiedenen Temperaturen.)) M. HANSEN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 25–37; also in *Zeitschrift für Physik*, Vol. 59, 1930, pages 466–496.

A phenomenon quite similar to that met in duralumin occurs in the β brasses of around 60 1/2 to 57 1/2% Cu. The β field is separated from the $\alpha + \beta$ field by a sloping line. Alloys quenched from above this line retain the β structure, but on aging at elevated temperatures, the transformation to $\alpha + \beta'$ occurs, since β' is the stable form below 453° C. The effect of quenching temperatures and aging temperatures was studied on 6 alloys in this range of compositions, and the effect of quenching rate (into water at 0°, 20° and 100° C.) was studied on a 59% Cu alloy. The necessary quenching temperature, of course, varies with the composition. The obtainable hardness rises as the composition, within the range of composition studied, approaches the high-copper side. Alloys of 60 to 60 1/2% Cu with about 115 Brinell as quenched, gave hardnesses of over 200 Brinell on aging at 150° C. for 8 days, 175° C. for 4 days or 200° C. for 18 hours. At 250° C. it reached 20 Brinell in less than an hour, but in 100 hours, it fell almost to the original value. At 300°, the hardness rose only to 160 Brinell after 10 minutes heating, and was reduced almost to the original value in 8 hours. Heating at 175° for 20 days showed no softening from the maximum hardness obtained in 4 days. Quenching into water at 0° or 20° made little difference, but quenching into boiling water was nowhere near so effective. The separation of β was followed by observing the change in electrical resistance which was rather similar to the change in hardness. There was no change in resistance or hardness that could be connected with the β to β' inversion, the behavior being as if β only were concerned. At aging temperatures of 250° C. and below, the increase in resistance appears to take place in 2 steps. A large increase in resistance is first shown, without a corresponding increase in hardness, after which the resistance falls while the hardness rises. The first change is ascribed to lattice distortion and internal stress; the second to separation of β. HWG(10f)

JOINING OF METALS & ALLOYS (11)

Brazing (11a)

Electric Resistance Brazing. W. C. Reed (General Electric Co.). *American Machinist*, Vol. 73, Nov. 13, 1930, pages 779–781.

Describes resistance brazing equipment. Silver alloys are used as the brazing media. Joints may be brazed by this process in less time than by soldering and the results are greater strength, greater electrical conductivity, and smaller joint. RHP(11a)

Soldering (11b)

A New Solder for Electrical Apparatus. James Silberstein. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 659–660.

Since the eutectic arrest at 182.5° C. in the system Pb–Sn reaches from pure Sn to 85% Pb, any Pb–Sn solder will fail at this temperature. Good soldering requires cleanliness of surfaces. A lead chloride flux permits a very tenacious adherence between Al and Pb although Pb and Al will not form an alloy. Observation of failure temperature of 5 soldered joints tabulated:

Alloy Comp.	45% Sn, 58% Pb	100% Sn	3.5% Sn, 96.5% Pb	2.5% Ag, 0.25% Cu, 97.25 Pb	100% Pb
Temp. of Failure	175°–179° C.	210°–214° C.	230°–239° C.	296°–301°C.	314°–317°C.

Temperature failure tests of various solders simultaneously observed indicate that pure Sn and $^{42}/_{58}$ Pb–Sn solders fail at the same current. In both cases the Ag–Cu–Pb alloy was superior. ESC(11b)

Soldering Aluminum. (Das Löten von Aluminium.) L. Rostosky & E. Lüder. *Apparatebau*, Vol. 42, Feb. 21, 1930, pages 37–42.

A discussion of the properties of the joints and their structure when welding or soldering Al. (11b)

Solders and Soldering Fluxes. A. Eyles. *Sheet Metal Worker*, Vol. 21, Oct. 3, 1930, pages 600, 608; Oct. 31, 1930, pages 668, 672; Nov. 14, 1930, pages 688, 706.

Fabrication, composition and use of various solders and fluxes, British research of solders and metallurgy of soldered joints. GN(11b)

Welding & Cutting (11c)

Influence of Flux Coated or Covered on the Metal Arc Electrode. M. Haramiishi (Tokyo Salvage Company, Ltd.). *Journal American Welding Society*, Vol. 9, June 1930, pages 33–46.

During metallic arc welding not only is there a physical change in metal structure taking place in the electrode caused by the heat of the arc but there is also chemical change. After much study of this intricate subject it was found that: (1) Any desired metal can be obtained chemically in the deposited metal with the flux coated electrode, although wire core has some elements which are main components of the desired alloy metal, the flux has the other required elements; (2) by utilization of heat given off by the arc, the deposited metal can be chemically changed from that of wire core with the prepared flux; (3) chemical change occurs in the electrode as well as in the flux when the heat of the arc is applied; (4) flux works as a medium in supplying necessary elements for the desired alloy adjusting the heat temperature of the molten metal suitably and protects it against undesirable impurities. Tests were made with cast-iron, high-speed steel, high-Mn steel, hypo-eutectic steels, and gun-metal. Includes numerous photomicrographs. LFM(11c)

Copper Welding in the Chemical Industry. S. J. Mashl (Van Schaak Bros. Chemical Works). *Journal American Welding Society*, Vol. 9, June 1930, pages 46–53.

Tough pitch Cu is most suitable type of Cu for welding. Due to its affinity for O, deoxidizing agents such as P, boron suboxide, Al, and Si are used. Rod used must contain substance that will dissolve oxide or prevent its formation. Rod should have same melting point as article to be welded. Best results are obtained when rod is applied at same time that parent metal becomes molten. Recommends annealing weld after it has cooled. Describes welding procedure as carried out in the plant giving photographs showing applications of various types of welds. LFM(11c)

Welding of Super Code Pressure Vessels. L. H. Burkhart (Struthers-Wells-Titusville Corp.). *Journal American Welding Society*, Vol. 9, June 1930, pages 28–32.

Gives results of tests carried out on welded specimens. In tensile tests no specimen broke in or near the weld showing that weld is stronger than the plate. Ductility tests were made by bending in a hydraulic press. Elongation ranged from 16 to 20%. Special tests were made on specimens of all weld or deposited metal which showed why no specimen broke in the weld. Tensile strength of weld metal is 50% greater than that of plate used and elongation 20% greater and reduction of area 30% greater. Gives tables and photographs. LFM(11c)

Welding as Performed at Present. J. W. Urquhart. *Heat Treating & Forging*, Vol. 16, May 1930, pages 595–597, 602.

Considers and compares the different methods of electric welding used in Europe. A point brought out is that certain kinds of rods work best when the current supplied to them is from the negative pole instead of the positive, the latter being earthed. Author's experiments indicate that the composition of the steel being welded has more influence than that of the rod in determining the polarity of the rod. MS(11c)

Welding Aluminum Castings. *Foundry*, Vol. 58, June 15, 1930, page 55.

Prior to welding the piece is usually preheated, temperature being raised slowly to proper heat. Illustrates and describes method of procedure on a lid of a rotary bottling machine 56 in. in diameter and $^3/_4$ in. thick. VSP(11c)

New Developments in Tube Welding. Ferdinand Owesney, Jr. *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 620–621.

From *Die Rohrenindustrie*, Vol. 23, Oct. 23, 1930, pages 339–340. Discusses application of medium and high frequency induction welding. Machine in which the principles are applied will be placed on the market in the near future. MS(11c)

Cutting Up Heavy Scrap with Oxygen Lance. *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 644–645.

From *Oxy-Acetylene Tips*. MS(11c)

Acetylene-Electric Welding. (Azetylen-elektrisches Schweissen.) Adrian. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, page 1584.

The author describes a new method of welding with acetylene and electric arc combined as it has been developed by IG-Farbenindustrie and AEG. The advantage of protection against the air of the acetylene flame and local heating and purity of heat source of the electric arc are combined in this way. The electrode of the electric circuit is introduced into the acetylene flame which proceeds in the direction of welding and pre-heats the edges. Alternating current is used; the amperage is lower, the voltage somewhat higher (about 33 volts). The welding speed is greater than in acetylene welding, about double for a plate of 6 mm.; the costs are about 30% lower. The quality of the joint is good but the human factor has a considerable influence, as this method cannot as yet be made automatic. Ha(11c)

Stress Distribution in Side-Welded Joints. W. H. Weiskopf & Milton Male. *Journal American Welding Society*, Vol. 9, Sept. 1930, pages 23–48.

Presents 3 new features in connection with side-welded joints; that is, joints in which the welds are disposed parallel to the direction of stress: (1) A theory as to the manner in which welds deform under shearing loads and, resulting therefrom, a determination of the value of the Detrusion Ratio, D. (2) A means of determining the effective areas of the bars composing such a joint (the percentage of the total areas that should be considered as transmitting load). (3) A method of determining the length of the welds, such that the maximum shear stress will not exceed the average design stress by more than any desired ratio. These are offered not with idea that problem is completely solved, but as practical suggestions that may be used with safety pending further investigation. In the 1930 test it was impossible to reconcile theory presented with only one short weld specimen tested so no definite conclusions could be drawn. Highly theoretical discussion is given with many graphs, diagrams, and formulae. Summary of results of thesis presented at Univ. of Pittsburgh by Haven, Logan and Hobe. LFM(11c)

Principles of Steel Mill Practice Applied to Welding. J. B. Austin (Una Welding & Bonding Co.). *Rolling Mill Journal*, Vol. 4, June 1930, pages 319–322.

Abstract of a paper read before the Association of Iron & Steel Electrical Engineers, June 16–20, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. MS(11c)

Investigations into the Influence of Covered Welding Electrodes on the Mechanical Properties of the Welds. (Untersuchungen über den Einfluss von Umwicklungen der Schweisstäbe auf die mechanischen Festigkeitseigenschaften der Schweisse.) K. Baumgaertel. *Forschungsarbeiten auf dem Gebiete des Ingenieurwesens*, published by the Verein deutscher Ingenieure, No. 336, 1930, 33 pages.

It has been found that the absorption of oxygen and nitrogen from the surrounding air during welding reduces the mechanical properties of the weld; to exclude or to reduce this influence the welding rods are provided with a kind of covering or are dipped. In order to obtain a clear view on this question tests were made with the following kinds of welding rods: (1) bare rods; (2) dipped rods of the American Welding Process Co. (*a*) intermediate, (*b*) normal; (3) asbestos covered rods of the same company, (*c*) special A, (*d*) special B, (*e*) low volt, (*f*) standard. The rod itself had the following composition in all cases: 0.11 C, 0.01 Si, 0.41 Mn, 0.023 P, 0.037 S, remainder Fe. In the covered rod, asbestos takes the place of a flux. The chemical composition of the coating is given in detail for every kind of rod used and contains especially calcium- and aluminum-silicates. The test results showed that the 2 light coverings *a* and *b* do not materially influence the tensile properties and simply facilitate welding. The asbestos covered rods, however, covered with a flux show a decided favorable influence as illustrated by physical, chemical, metallographic, and X-ray tests. Of course, the proper chemical composition of coating is necessary, correct manipulation of the rod, and proper care in welding. The least influence was found in the Brinell test, while tensile strength and elongation showed considerable improvement compared with bare electrodes; the same was true also for bending tests, some of the samples could be bent 180° without fracture. X-ray tests showed finer-grained structure for covered electrodes. Ha(11c)

Gas Welding Machines in Germany. K. P. Berthold. *Welding*, Vol. 1, Oct. 1930, pages 815–819.

Begins with an enumeration of the various applications of welding in Germany, which are practically the same as in the U. S. Germany is gradually overtaking the great lead the U. S. has enjoyed in this field. Gas welding is still preferred in Germany to electric seam welding, opinion being that a seam subjected to heavy stresses should preferably be gas welded, for such a seam is always tougher and stronger than an electrically welded one. This conservative attitude is strengthened by the consideration of the cost of installing an electric welding set. The Mauser seam welding machine, a machine for welding heavy containers, and circular seam welding machines for special purposes are described. Concludes with a survey of the basic factors determining the economical use of automatic welding. As a rule, welding machines are applicable only in case of mass production. W(11c)

Shrinking Stresses and their Consideration in Arc-Welding. (Schrumpfspannungen und ihre Beachtung beim Lichtbogensschweissen.) Bondy. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, page 1560.

It is suggested that the initial interior stresses in structural material which are opposed to those actually existing later in service be produced by welding; this might lead to a reduction in weight. Lottmann, in a reply, believes that before practical use it should be ascertained whether these initial interior stresses remain constant or if they will disappear in time. Ha(11c)

Safe Welding of Empty Barrels for Mineral Oils. (Gefahrloses Schweissen von Entleerten Mineralölfässern.) Brauer. *Schmelzschweissung*, Vol. 9, Dec. 1930, pages 272–274.

Very often accidents are caused due to welding or soldering done on empty barrels which had been filled with mineral oils. A mixture of benzine vapor and air is explosive at a ratio of 2.5 to 4.0% vapor in 100 parts of the mixture, that is, in a barrel of 200 l. contents 10 to 25 g. of benzine are required; the explosion is the most violent for 17 to 20 g. Such residues of oil can be held by films of corroded material on the inside. The author discusses and describes several methods of eliminating the formation of vapors of which the best seems to be rinsing with water before welding until no trace of oil can be discovered on the surface of the water. It is absolutely necessary to instruct the personnel thoroughly as to the danger of work on empty oil barrels and tanks. Ha(11c)

A Year of Arc Welding. A. M. Candy. *Welding*, Vol. 1, Jan. 1930, pages 159–161.

Reviews commercial activities in the general arc welding business for 1929, which was greater than in any other 12-month period. A curve illustrates increase in this business by quarterly periods since Jan. 1927. W(16)

Welding Courses in Engineering Schools. George B. Cox. *Welding*, Vol. 1, Jan. 1930, pages 149–153.

The elementary and advanced training course for the technical students of Oregon State College. W(11c)

Destruction Test of an Electrically Welded Superheater Drum. O. L. Cox. *Mechanical Engineering*, Vol. 52, Dec. 1930, pages 1063–1064.

Description of procedure of test and results. GN(11c)

Welding Practice in the C. B. & Q. Railway Shops. Joseph C. Coyle. *Welding*, Vol. 1, Oct. 1930, pages 820–823.

Welding is especially applicable for use in railroad shops because of the saving that can be effected by repairing and reclaiming various equipment, such as cross heads, smoke stacks, frames, wheels, cylinders, drawing boxes, front end plates, flues, both the arc and oxy-acetylene processes being used. For example, worn cross heads, costing $75.00 or more new, are reclaimed by arc welding for about $5.00 each; cast iron smoke stacks, costing $40.00 new, are reclaimed with acetylene torch for about $9.00. A description of the equipment, procedure and some of the structures reclaimed is given. W(11c)

Much Arc Welding in New Liquid CO_2 Plant. A. F. Davis (Lincoln Electric Co.). *Chemical & Metallurgical Engineering*, Vol. 37, July 1930, page 435.

Much of the stacks, piping, absorbing towers, and tanks in the plant of the Liquid Carbonic Corporation at Cleveland, Ohio, is fabricated by arc welding. MS(11c)

WORKING OF METALS & ALLOYS (12)

Melting and Refining (12a)

High-Quality Basic Open-Hearth Steel. *Iron & Coal Trades Review*, Vol. 121, Aug. 22, 1930, page 262.

Abstract of Technical publication, No. 347 of the American Institute of Mining and Metallurgical Engineers on "Practical Observations on Manufacture of Basic Open-Hearth, High-Carbon Killed Steel," by W. J. Reagan See *Metals & Alloys*, Vol. 1, Nov. 1930, page 852. RHP(12a)

Making Wrought Iron Mechanically in 700 lb. Balls. *Iron Age*, Vol. 125, June 19, 1930, pages 1814–1817.

Describes method employed by the Wrought Iron Co. of America, Lebanon, Pa. Time in puddling operation is saved by melting pig Fe in oil-fired furnace, whence it is taken in 700 lb. installments and poured into rotary furnace. Operations in rotary furnace are similar to those involved in hand-puddling, except that melting takes place elsewhere. Operation is either by oscillation or rotation. Each heat requires about 45 minutes. VSP(12a)

The Analysis of Basic Slags and the Representation of Their composition in a Triangular Diagram. OTAKAR QUADRAT. *Engineer*, Vol. 150, Oct. 3, 1930, page 360.

An abstract of a paper read before the Iron and Steel Institute, Prague, Sept. 16, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. LFM(12a)

Open-Hearth Trends During 1929. L. F. REINARTZ (American Rolling Mill Co.). *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 96–99.

Progress in furnace construction is toward larger capacities. Construction of roofs, ports, valves, dampers and checkers is being improved. Fuel is being conserved by means of insulation and better furnace control. European steel men do not favor the very large stationary furnace. Research in steel-making processes is aiding the open-hearth operator. MS(12a)

Basic Open-Hearth High Carbon Killed Steel. W. J. REAGAN (Edgewater Steel Co.). *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1473–1475, 1481; Oct. 1930, pages 1611–1612, 1618.

Paper read before the Iron & Steel Division of the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 852. MS(12a)

Calcium Molybdate, Iron and Steel Making. THOMAS W. HARDY (Mines Branch, Department of Mines, Canada). *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 613–617; May 1930, pages 784–788, 795; *Heat Treating & Forging*, Vol. 16, April 1930, pages 471–474, 480; May 1930, pages 608–613.

Outlines the history and occurrence of Mo, its effect on the properties of steel, its early applications to ferrous metallurgy, the use of the ferro-alloy as an addition agent and particularly the development of $CaMoO_4$ as an alloying agent. Experimental heats using the compound as an addition were made in 1918, and a U. S. patent was granted to Alan Kissock on April 15, 1919. However, it was not until 1925 that the process became generally used. Discusses characteristics of $CaMoO_4$. In the basic electric furnace, it is the slag which accomplishes the reduction of the salt whereas, in the open-hearth furnace, it is probable that the Fe is mainly responsible. Recovery of Mo from $CaMoO_4$ is as high as that from the ferro-alloy. $CaMoO_4$ cannot be used satisfactorily to introduce more than $1^1/_2$% Mo. As a general rule in steelmaking, the molybdate should be added before or during the period in which a heat is being "worked down." The most generally used methods of applying it in the basic open-hearth process are (1) to add it after the lime begins to "come up" and before slag is formed and (2) to add it after the slag has formed but at least 2 hrs. before tapping. Method (2) is generally used in the acid open-hearth process. Usual practice in the basic electric process is to add it either on the bare metal just after skimming off the slag, or immediately after the CaO has been thrown in. Best practice in the acid electric process is to charge it with the scrap. In converter practice, the requisite number of bags are thrown into the vessel and the hot metal poured on top of them. In the crucible process, if the Mo content in the steel does not exceed 0.30%, the molybdate is placed in the middle of the charge in the crucible. For higher percentages, it is unsatisfactory. It cannot be successfully added in the ladle. Best practice in the air furnace is to distribute the requisite number of bags throughout the charge. Use of $CaMoO_4$ in the cupola is not recommended unless the cupola is producing nothing but Mo iron. It is charged on each layer of coke in sufficient amount to introduce the desired percentage of Mo into the layer of metals immediately above. It is preferable to use briquetted $CaMoO_4$. Mo pig-iron may be produced by mixing the briquetted molybdate with iron ore and charging into the blast furnaces. This has not been done commercially, however. $CaMoO_4$ is an ideal starting point for the manufacture of ferro-Mo. Mo in small percentages has been successfully alloyed with certain non-ferrous metals by adding the molybdate to the molten metal in the electric furnace. The salt is particularly suited for reduction by Si or alumino-thermic methods. MS(12a)

Steel Castings. C. HOWELL KAIN. *Foundry Trade Journal*, Vol. 41, Dec. 5, 1929, pages 403–404; Dec. 12, 1929, pages 422–425.

The author discusses details of the production of electric steel castings. In experiments on a duplex process, hot cupola metal was charged into an electric furnace and ored down to 0.1% C and the oxidizing slag then removed. The bath was boiling gently at this point. A reducing slag was built up and the heat finished as quickly as possible by Fe-Si and Fe-Mn additions. The steel, when tapped, although not unduly hot had a high degree of fluidity with an absence of wildness. The recovery of Si is increased from 65% of the amount charged when the Fe-Si is added directly after the removal of the oxidizing slag to 135% when the Fe-Si is added only after the reducing slag has been built up. This high yield is explained by the fact that in addition to some Si being reduced from the slag, the Fe-Si is added when the bath is quiet and there is little tendency for the Si or silica to be removed by the boil. Al or Ti can be used for final degasification. The action of Al is instantaneous while Ti gives its best results only when the metal is allowed to stand from 3 to 5 min. before pouring. Molding methods used in the solution of several difficult casting problems are discussed. (12a)

Certain Methods of Deoxidizing Steel. J. M. GAINES, JR. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 102–104.

Present methods of deoxidation result in the formation of non-metallic inclusions in steel. After considering the factors which necessitate deoxidation, proposes a method making use of the rodding reaction. First stage of the process would be the removal of the slag, substituting an inert material such as a lime-clay mixture. In some cases it might prove feasible simply to thicken the existing slag to the point where slag-metal reaction is sufficiently retarded. Second stage would be deoxidation by the introduction of solid objects such as rods, or if C is low, lumps of washed metal or bars of graphite. Tubes through which N is blown into the bath might be used instead of rods. Advantages of the method would be lower inclusion content of the finished product, with consequent reduction in chipping costs, and a saving in the amount of ferro-alloys used. Chief disadvantages appear to be the time and material represented in the exchange of slags. MS(12a)

Casting & Solidification (12b)

Properties of Die Castings Affected by Casting Practice. CHARLES PACK. *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1386–1388.

Taken from a paper read before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers at the National Metal Congress. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 852. VSP(12b)

On the Volume Change of Manganese and Some Alloys which Contain Nickel or Cobalt during Solidification. K. HONDA, Y. MATUYAMA & Y. ISOBE. *Kinzoku no Kenkyu*, Dec. 1930, pages 635–639.

The volume change of alloys: nickel-carbon eutectic (2.23% C), cobalt-carbon eutectic (2.20% C), manganese-carbon (1.1% C) and distilled pure manganese has been measured by means of a thermobalance. The authors showed that pure manganese and manganese-carbon alloy which forms a solid solution at high temperature contract during solidification, the former, by 4.5% and the latter, by 1.60%. But the alloy nickel-carbon eutectic expands by 2.06% and the cobalt-carbon eutectic by 2.03%. This expansion is caused by the formation of graphite during solidification; the specific volume of the graphite is very large as compared to that of nickel or cobalt. KT(12b)

Designing for Aluminum Die Castings. D. B. HOBBS. *Product Engineering*, Vol. 1, Feb. 1930, pages 60–62.

The die-casting process consists in forcing molten metal under considerable pressure into steel dies. The main characteristics of die castings, their extreme accuracy, uniformity and superior finish are the result not only of the method by which the castings are made, but also of the fine art developed in die construction. The fact that Al alloys have a higher melting point than Pb, Sn, and Zn alloys required the development of special alloy steel dies. A general description of the casting process is given. (12b)

Ingot Phase in the Manufacture of Rolled Steel Products. Pt. I–VI. JOHN H. HRUSKA. *Rolling Mill Journal*, Vol. 4, Apr. 1930, pages 145–148; June, 1930, pages 309–312, 318; July, 1930, pages 367–370; Aug. 1930, pages 417–418, 430; Sept. 1930, pages 471–473; Dec. 1930, pages 681–682, 687–688.

Deals with the importance of the teeming phase for the production of good rolled products; top and bottom pouring practice; solidification of steel ingots; types of molds and their influence on the soundness of the ingots; formation of dendritic structure; causes of blow-holes in ingots and means for their reduction; location and extent of segregation and teeming practice for its diminution; and inclusions in steel. MS(12b)

Cast Iron or Steel Stools for Ingot Molds. JOHN H. HRUSKA. *Iron Age*, Vol. 126, Oct. 2, 1930, pages 920–921, 974–975.

Most economical method is to make stools and molds from alloy gray Fe or alloy cast steel. Structural changes of stool metal are accompanied by changes in shape or cross-section of stool. Most important feature in stool design is proper consideration of central overheating of stool in filling the mold. Stool should receive the same care and attention in design, maintenance and storage as ingot molds. Includes a table giving composition of metal in stools. VSP(12b)

Centrifugal Castings of Metals. (La coulee centrifuge des metaux.) HENRI CESSELIN. *Revue de Metallurgie*, Vol. 27, June 1930, pages 301–315.

Attention called to the lack of centrifugal casting plants in France. General principles of centrifugal casting in chills are given and their application illustrated by the practice of U. S. Cast Iron Pipe and Foundry Co., Birmingham. Casting in heated molds and casting of billets is given as an abstract of Leon Cammen papers (*Iron Age*, Vol. 110, page 655; *Transactions American Society for Steel Treating*, Vol. 11, page 915, etc.). JDG(12b)

The Heterogeneity of an Ingot Made by the Harmet Process. A. KRIZ. *Engineering*, Vol. 130, Sept. 19, 1930, page 371.

Abstract of discussion of papers read before the Iron & Steel Institute, Sept. 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. LFM(12b)

The Heterogeneity of an Ingot Made by the Harmet Process. ANT. KRIZ. *Engineering*, Vol. 130, Oct. 31, 1930, pages 565–567.

Condensed from paper read before the Iron and Steel Institute, Prague, Sept. 15, 1930. *See Metals & Alloys*, Vol. 1, Dec. 1930, page 915. LFM(12b)

Castings for Bronze Gears. FRANCIS W. ROWE (Davis Brown & Sons). *Metallurgia*, Vol. 3, Dec. 1930, pages 50–52.

Cu wire bars and Banks Sn should be used in making the alloys. Correct melting practice is also required. Weak and unsound castings may be due to either poor raw materials or to faulty melting practice. JLG(12b)

The Electric Heating of Ingot Tops in Order to Obtain Dense Ingots. (Die elektrische Blockkopfbeheizung zur Erzielung dichter Stahlblöcke.) EBERHARD LETIXERANT. *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, pages 1801–1805.

Report 185 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The equipment for the electric heating of steel ingot tops, as supplied by Börnecke & Borchart, Witten, Germany, is described. Practical results of this new method are given, with detailed information as regards the cost. An essential saving of steel can be accomplished because the amount of scrap decreases. The method was tested in 7 different German steel plants on ingots from 15 to 100 tons. GN(12b)

Large Centrifugal Castings Made at Navy Yard. JOSEPH F. CROWELL (U. S. Navy). *Iron Age*, Vol. 126, Oct. 9, 1930, pages 994–996, 1047.

Centrifugal method is highly satisfactory for production of hollow cylindrical castings, which must be non-porous, of uniform texture and hardness, close-grained and free from blow-holes. Molds in large machines are lined with sand. Both horizontal and vertical machines are used at Navy Yard. Casting babbitt metal on inside surface of a bearing brass, the bearing brass forms the insert. Barrel for largest machine is made from 13 in. naval gun. Maximum speed of barrel is over 750 r.p.m. Speed during pouring depends on size of casting and material used. At present no definite information is available regarding % of losses to be expected. VSP(12b)

The Formation of Graphite in Cast Iron. (Die Graphitbildung in Gusseisen.) O. VON KEIL. *Archiv für Eisenhüttenwesen*, Vol. 4, Nov. 1930, pages 245–250; *Stahl und Eisen*, Vol. 50, Dec. 4, 1930, pages 1718–1719.

The investigation attempts to settle the dispute on the formation of graphite in cast Fe as to whether there is the formation of graphite due only to the decomposition of cementite or a direct crystallization of graphite, or both occurrences simultaneously. It was found that the needle-like formation of graphite indicates the direct crystallization in the liquid phase, whereas the finely distributed graphite indicates a metastable crystallization with succeeding decomposition. It was furthermore proven that every cast Fe, dependent on the C content, has a critical cooling velocity which, when underpassed, results in a stable crystallization (needle graphite) but in a fine crystallization of graphite when exceeded. The influence of superheating on the crystallization was studied. In superheating, the critical cooling velocity is shifted to very low values, i. e., superheated cast Fe, even for slow cooling, crystallized metastable with following decomposition. The results confirm investigations by Piwowarsky and Hanemann. GN(12b)

Rolling (12c)

Modern Lubrication in Steel Mills. (Neuzeitliche Schmierung in Eisenhüttenwerken.) E. CHRISTIAN. *Stahl und Eisen*, Vol. 50, Oct. 23, 1930, pages 1501–1502.
The article emphasizes the economics of centralized pressure-lubrication systems in steel plants. Figures are given showing the decrease of power consumption in rolling mills in using pressure lubrication. GN(12c)

New Types of Rolling Mill Guides. (Neuerung an Walzwerksführungen.) O. ROLOFF. *Stahl und Eisen*, Vol. 50, May 1, 1930, pages 602–603.
The author points out the usefulness of alloy steel tips for rolling mill guides in all cases where excessive wear occurs. Guides provided with these tips showed a lifetime 8 to 10 times longer than that of regular cast iron guides. GN(12c)

Continuous Rolling Mills for Materials of High Hot Tensile Strength. (Kontinuierliche Walzenstrasse für Werkstoff mit hoher Warmfestigkeit.) W. ROHN. *Stahl und Eisen*, Vol. 49, Dec. 5, 1929, pages 1757–1760; Dec. 12, 1929, pages 1793–1797.
Some continuous rolling mills for rolling materials of high hot tensile strength are described in detail. These mills are efficient in spite of the low capacity they have in part, not more than 300 tons/yr. The experiences with these mills lead to the belief that this new type of mill can also be successfully used for rolling steel of high hot tensile strength. GN(12c)

Modernization of a Rolling Mill for Strips and Hoops. (Mechanisierung einer Walzenstrasse für Röhrenstreifen und Bandeisen.) B. QUAST. *Stahl und Eisen*, Vol. 50, Feb. 13, 1930, pages 206–207.
The article describes the accomplishment attained by modernizing an old type two-high mill, particularly the following: 80% decrease of wages, lower power consumption, the possibility of rolling products of greater length, a smaller thickness, avoiding of scale due to the sharp bending of the steel in the repeaters and increase of the capacity of the mill. GN(12c)

Lateral Pressure in Box Passes. (Die Notwendigkeit des seitlichen Druckes in geschlossenen Kalibern.) HEINZ PUPPE. *Stahl und Eisen*, Vol. 50, Dec. 11, 1930, page 1750.
The author shows that it is advisable to use alternatively open and box passes in rolling shapes like U's, beams, rails and similar heavy sections. In order to obtain a uniform elongation of the individual parts of such complicated cross-sections, it is preferable to give a slight lateral pressure in the first shaping box passes. GN(12c)

The Development of Mechanical Cooling Beds. (Die Entwicklung der mechanischen Kühlbetten bis zu den Krupp-Hochleistungskühlbetten.) E. KÄSTEL. *Krupp'sche Monatshefte*, Vol. 11, Sept.–Oct. 1930, pages 255–265; *Iron & Coal Trades Review*, Vol. 121, Sept. 12, 1930, pages 360–361.
The article gives an illustrated description of modern cooling bed constructions which meet the requirements of large productions. GN(12c)

Design of Mills for Flat Flanged Beams. *Blast Furnace & Steel Plant*, Vol. 18, May 1930, page 832; June 1930, page 1034.
Outlines development of mills for rolling wide flanged beams. Most modern universal mill for this purpose is the Pulle mill. MS(12c)

Roller Bearings for Modern Cold Rolling Mills. (Ueber neuzeitliche Kaltwalzwerke mit Rollenlagern.) GUNNAR PALMGREN. *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, pages 1805–1812.
After discussing the disadvantages of solid bearings, the correct selection of roller bearings is pointed out and various types of modern roller bearings are described and illustrated. Solid bearings and roller bearings are compared. The conclusions which are reached show the advantages of roller bearings. GN(12c)

The Development of the Sheet Bar Mill. (Die Entwicklung des Platinenwalzwerkes.) W. KRÄMER. *Stahl und Eisen*, Vol. 49, Nov. 14, 1929, pages 1653–1654.
The present practice in Germany is to roll sheet-bars in widths of 180, 200, 220 or up 250 mm. A new method is suggested for increasing the capacity of sheet-bar mills and decreasing the cost. GN(12c)

Improvements of Reels for Reeling Rods. (Neuerungen an Drahthaspeln.) W. KEHRMANN. *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, pages 1816–1817.
The new type of reel which the author describes is a combination of a Garret reel and an Edenborn reel, which makes it possible to throw a reeled rod bundle vertically down on a conveyor. GN(12c)

Ball and Roller Bearing in the Steel Mill. D. E. BATESOLE (Norma-Hoffmann Bearings Corp.). *Rolling Mill Journal*, Vol. 4, July 1930, pages 353–358.
Discusses fundamental principles of mounting anti-friction bearings and some typical applications to equipment, such as roll necks, cut-off saws, table rollers and mill motors. MS(12c)

Forging (12d)

Forging Machine Practice. W. S. DEWELL. *Machinery* (London), Vol. 35, Feb. 20, 1930, pages 676–677.
Discussion of design of forging-machine dies for making torque tube flanges; includes an outline of 3 operations. (12d)

Construction of Dies for Forging. A. ALLEN (Angus Engineering Works). *Heating Treating & Forging*, Vol. 16, July 1930, pages 861–863.
Explains construction of dies for various types of forgings. MS(12d)

Manufacture of Large Steel Forgings. ADOLPH O. SCHAEFER (Midvale Co.). *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 43–47.
Outlines the different steps in the production of very large forgings and the special precautions taken. MS(12d)

Machining (12g)

Modern Cutting Tools for Machine Tools. J. B. RENNIE. *Edgar Allen News*, Vol. 9, Nov. 1930, pages 745–748.
Observations on cutting tools generally, with special reference to tipped tools. Author suggests a standard nomenclature applicable to all cutting tools for any machine tool. Considers the merits of the curved nosed and straight nosed roughers; the importance of side slope; the effect of back slope on side slope; the plan angle, for use on different materials; the diamond nosed tool; a standard roughing tool. W(12g)

The Lapping of Tungsten-Carbide Tools. H. J. WILLS (Carborundum Co.). *Machinery*, Vol. 36, May 1930, pages 718–719.
A lapped cutting edge on a tungsten-carbide tool has from 2 to 4 times the life of a ground edge. The process has not been generally used because of the high cost of diamond dust which costs from $9000 to $25,000 per pound. A working edge superior to that produced by diamond dust has been produced by an abrasive costing only 70 cents per pound. This is a carborundum finishing compound. The method of lapping with this abrasive is described in detail. RHP(12g)

Working Chromium-Nickel Alloys with Light Equipment. G. PARIOT. *Sheet Metal Worker*, Vol. 21, Nov. 28, 1930, pages 710–711, 714.
A recital of practical experience in working Cr-Ni alloys with light equipment. Special reference is made to difficulties in drilling and soldering these alloys. GN(12g)

Milk as a Coolant. JOHN KAPP. *American Machinist*, Vol. 73, July 10, 1930, page 45.
Milk has been used with good results with both carbon and high speed steel cutters. RHP(12g)

A Machine Tool Builders' Experience with Tungsten-Carbide Tools. *Iron Age*, Vol. 126, July 3, 1930, pages 10–13, 60.
Describes experiences of William Sellers & Co., Inc. Tungsten-carbide tools are carried in tool room from which operator can draw them upon proper authorization. New applications are followed up by the tungsten-carbide expert, and if adopted, the rate department adjusts piece work price. Written instructions are given operators. Proper grinding of cutting edge is very important. Clearance angles should be somewhat less than those for high speed steel. Hand grinding has been eliminated. Machine grinding permits use of water; grinding charts are used. Lapping after grinding will produce a keener edge. Tools chip and break if shank is too light, or too much Cu in the braze. Outstanding applications of the tools include planing of large ring gear segments on a 72 × 72 in. planes; planing 10 ft. boring mill uprights and planing beb of floor boring machine. Summarizes advantages and disadvantages of tungsten-carbide tools. VSP(12g)

Tooling for the Newer Metals. JOHN HAYDOCK, JR. *American Machinist*, Vol. 73, Sept. 18, 1930, pages 459–463.
Discusses the design of tools adapted to the cutting of the more recently developed alloys. Gives special requirements for each metal. RHP(12g)

Successful Use of Cemented Tungsten Carbide Demands Careful Study. J. GESCHELIN. *Automotive Industries*, Vol. 63, Oct. 18, 1930, pages 544–549, 559.
Survey of practical results in the use of cemented tungsten carbide tools. Detailed reference to rakes, angles and clearances of these tools. Grinding should be centralized and a careful operator selected who has proper equipment. GN(12g)

Our Experience with Tungsten-Carbide Tools. J. B. DOAN (American Tool Works Co.). *Machinery*, Vol. 37, Sept. 1930, page 6.
Carboloy tools used since Mar. 1929. Used for turning and boring column sleeves for radial drills, the columns themselves, column rings, rough-turning of lathe face-plates, turning cast Fe sleeves for both radial drills and lathes, machining semi-steel gear blanks. Discusses rate and depth of cut used. Savings have resulted from use of carboloy tools but they cannot be used successfully with out-of-date machines. RHP(12g)

Cutting Tests with Cemented Tungsten Carbide Lathe Tools. T. C. DIGGES. *Bureau of Standards Journal of Research*, Vol. 5, Aug. 1930, pages 365–368; *Engineer*, Vol. 150, Sept. 5, 1930, pages 247–249.
This investigation was made for the purpose of developing a method of testing cemented tungsten carbide lathe tools under heavy duty and to extend to the new cutting material some of the laws originally developed by Taylor and his associates for cutting with C and high-speed steel tools. Relations were determined between the speed, feed, depth of cut, and tool life for a selected form and size of tool. All tests were made dry in cutting 3.5% nickel-steel forgings, heat treated to give tensile strengths within the range of 85,000 to 110,000 lbs./in.^{2} The results are presented in both graphic and tabular forms. See extended abstract in *Metals & Alloys*, Vol. 1, Nov. 1930, pages 836–839. LFM+ESC(12g)

Tungsten Carbide—The First Product of a New Metallurgy. GREGORY J. COMSTOCK (Firth-Sterling Steel Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1381–1383.
From a paper read before the National Metal Congress. Outlines the history, composition, characteristics and manufacture of tungsten carbide. VSP(12g)

Modern Metal Cutting Tools. *Engineering*, Vol. 130, Sept. 26, 1930, pages 400–401.
Editorial briefly reviewing the recent improvements made in cutting tools. Stellite, Cooperite, Widia, and tungsten carbide tools in general are discussed. Comments on paper read before the Detroit meeting of the American Society of Mechanical Engineers by T. G. Digges who gives results of an investigation on cemented tungsten carbide lathe tools. For these tests, the tungsten carbide tip was brazed on to a steel shank. Material tested was $3^1/_2$% Ni steel having tensile strength of 43 tons/in.^{2} Author attempted to work out relation of cutting speed and depth of cut to life of tool. LFM(12g)

Drawing & Stamping (12h)

Selection of Sheet Steel for Deep Drawing. W. H. GRAVES. *American Machinist*, Vol. 72, May 1, 1930, pages 718–719.
Criteria for workability and physical properties are discussed. See *Metals & Alloys*, Vol. 1, July 1930, page 633. (12h)

Die Pressing of Brass and Copper Alloys. JOHN R. FREEMAN, JR. (American Brass Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 391, 1931, 8 pages.
Die pressings are made from almost all of the copper base alloys. A brass of about 60% Cu—2% Pb is frequently used on account of its good forging characteristics and excellent machinability. Parts are usually forged from pieces cut from extruded shapes. The presses may be of the drop, crank, or screw type. Various types of dies and parts made from them are described. JLG(12h)

How Ford Forms and Polishes Rustless Steel Radiator Shells. *Iron Age*, Vol. 125, June 26, 1930, pages 1887–1888.
In drawing rustless steel more pressure is required on the drawing ring than is the case with ordinary steel. Drawing rings are made of special cast Fe of close grain. All drawing surfaces are finished with a stone instead of an emery wheel. Seventeen operations are used in forming a radiator shell. Shells are polished with 180 mesh abrasive followed by a 200 and 244 mesh emery. Surplus pieces from pan are used for making small parts. VSP(12h)

Metal Stamping Dies. Parts XIX–XXI. ELLSWORTH E. CLARK (Westinghouse Elec. & Mfg. Co.). *Metal Stampings*, Vol. 3, Feb. 1930, pages 153–156, 164; April 1930, pages 323–328; Aug. 1930, pages 737–740, 744.
Discusses proper care and use of dies; factors affecting choice between built-up and solid types of die construction and applications, general construction, and advantages of pierce and sever or parting dies. MS(12h)

Blanking and Forming of Can Ends. H. F. BAYER (Continental Can Co.). *Metal Stampings*, Vol. 3, Jan. 1930, pages 55–56.
Two-part type of die is used for forming 2 complete can ends at each stroke of press. Blanking rings are made from Cromovan. The punches and the forming dies are made from 2 other kinds of steel. Each die receives 8 regrindings and one closing-up during its useful life. MS(12h)

Pickling (12i)

Formation of Hydrogen on Pickling. (Die Wasserstoffentwicklung beim Beizen.) H. BABLIK. *Korrosion und Metallschutz*, Vol. 6, Oct. 1930, pages 223–228.

Iron samples heavily scaled were pickled in hydrochloric and sulphuric acid and the hydrogen liberated was quantitatively measured. Instead of the conventional function $H = f(t)$ the author determined the reaction velocity $v = dH/dt = f'(t)$. The data are collected in 9 diagrams. The influence of inhibitors, the diffusion of hydrogen in both pickling acids, the influence of their concentration and of the temperature are considered. EF(12i)

Cold Working (12j)

Life of Cold-Heading Die Depends on Five Factors. A. S. JAMESON (International Harvester Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1368–1369, 1436–1437.

Paper read before the American Society for Steel Treating at Chicago. Describes investigation on the maximum die life from certain type of cold-headed bolt die. Maximum production depends on die steel, die design, heat treatment, bolt material and machine operation. VSP(12j)

Should Steel Machinery Parts Be Cold Rolled? G. S. VON HEYDEKAMPF (Southwark Foundry & Machine Co.). *Iron Age*, Vol. 126, Oct. 2, 1930, pages 928–929.

Supplement of article published in *Iron Age*, Sept. 18, 1930. Cold working reduces elongation at fracture of tensile test pieces, and such elongation is considered a measure of ductility. Static ductility measures the ability of the material to withstand without fracture great plastic deformation at stresses near ultimate tensile strength. By cold rolling, not only is the fatigue strength increased, but endurance limit is shifted into a field of higher dynamic ductility. Results show that for 2 kinds of steels tested, the endurance limit increased about 15% and also dynamic ductility. VSP(12j)

Aluminum Spinning Practice. ROBERT J. ANDERSON. *Metal Stampings*, Vol. 3, June 1930, pages 513–517.

Equipment used and methods of tooling for Al spinning are practically the same as those for other non-ferrous metals. Higher speeds are possible with Al. Intermediate annealing is often necessary. Spinning is usually done on dead-soft annealed blanks of the commercially pure metal. Alloys are not generally used because they harden too rapidly. Heavier gages may be spun in Al than in other metals. Decribes operations involved, equipment and tools required, and applications. MS(12j)

Note on the Effect of Various Annealing Temperatures on Cold Worked Low Carbon Steel. H. E. PUBLOW. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 18–19.

Cold working of steel is generally accompanied by an increase in the hardness. Theories offered in explanation of the property of hardness generally assume a decrease in the size of particles. This paper offers a study of automobile brake drums which show an increase in Rockwell hardness numbers as great as 30 points over the raw stock due to cold working. Photomicrographs are presented to indicate no decrease in crystalline size. Curves showing the relation between annealing temperatures and Rockwell hardness as well as annealing temperatures and ductility are included. The relation between hardness and ductility is also plotted. These observations indicate that the changes must be due to reactions within the grains themselves not revealed by the microscope. ESC(12j)

Cold Roll Forming of Metals. Part IX. D. A. JOHNSTON (McKinney Tool & Mfg. Co.). *Metal Stampings*, Vol. 3, Jan. 1930, pages 19–24; Feb. 1930, pages 121–126; March 1930, pages 229–234; April 1930, pages 331–334; May 1930, pages 429–434; July 1930, pages 621–627; Aug. 1930, pages 711–714; Sept. 1930, pages 795–798; Oct. 1930, pages 893–894, 896.

Outlines applications of the process, kinds of metals and types of products that can be rolled formed, and typical features of cold roll forming machines. Discusses capacities of, and specifications for the non-overhung and overhung types of machines. Describes method of rating capacities of machines which is based on the maximum dimensions of the section that the machine will handle, and various factors involved in selecting a suitable machine. Discusses design of rolls with reference to least distortion of metal, hardening and grinding, life and replacement, etc., and design of entrance guides, lifting shoes, and various types of straighteners. Outlines supplementary operations, such as shearing, bowing, coiling, welding of tubing, and manual and automatic cutoffs. Treats of roll design and figuring of stock for simple sections which involve curling and forming; and roll pass design and factors to be considered in forming of ribbed roofing sheets. MS(12j)

Cleaning (12k)

Value of Compressed Air in the Finishing Room. WILLIAM F. CAHILL. *Metal Cleaning & Finishing*, Vol. 2, June 1930, pages 523–524, 538.

Compressed air may be used as a means of agitating cleaning baths to make them function more efficiently. Its use is more advantageous for ferrous metals than for non-ferrous, because of the danger of oxidizing the latter. It can also be used to dry metal surface before finishing, so as to prevent formation of rust. MS(12k)

Straight-Line Cleaning of Castings on Conveyors. E. F. MILTENBERGER. *Iron Age*, Vol. 126, July 3, 1930, pages 5–9.

Supplementing article on molding and pouring practices, etc. published in *Iron Age*, March 27, 1930. Three transit conveyor lines with occasional short lines for special purposes, run the length of the cleaning department of the Eastern Steel Castings, Newark. A complete system of weighing and checking of weights pervades entire plant. Cleaning begins on the shake-out. From the main lines castings are switched off for grinding operations. Several types of grinders are used. Chippers work in twos, each on his own table, with inspector between the 2 tables. Castings are repaired en route. Sheet steel trays are used for sorting. VSP(12k)

Polishing & Grinding (12l)

Polishing Stainless Steel Sheets to Bring Out Their Gleaming Luster. *Iron Age*, Vol. 126, July 24, 1930, pages 213–216.

Describes method employed by the Republic Steel Corporation at Massillon, Ohio. Steel is melted in electric furnace. Proper amount of ferrochrome being added when poured from ladle. The hot rolled sheets received the Strauss heat treatment in continuous furnace. After annealing sheets are pickled in solution of HCl, physical tests are taken of each lot. Polishing is followed by a soft buffing with a compound made of grease and chrome oxide. For fine-finish polishing, grit coated rollers are used, which in addition to rotating, the rollers have an oscillating motion. Final operation consists in dipping sheets in solution of HNO_3 from 2 to 15 minutes. Fabrication of the sheets. VSP(12l)

Polishing Chrome-Nickel-Alloy Steel Requires Care and Special Compounds. CURTIS C. SNYDER (Republic Steel Corp.). *Iron Age*, Vol. 126, August 7, 1930, pages 353–356.

Grinding and polishing high Cr-Ni alloy steel requires special compounds and high-speed buffing to obtain best results. On exterior applications the Tampico brush gives a good finish. Iron oxide buffing compound is undesirable. Core required in roughing. Tabulates results of tests made to remove cement and plaster adhesions. VSP(12l)

Coloring (12m)

Relation between Color and Structure of Alloys. IV. Iron-Carbon Alloys. (Die Beziehungen zwischen der Farbe und dem Feingefüge der Legierungen. IV. Eisen-Kohlenstoff-Legierungen.) MASUMI CHIKASHIGE & DENZO UNO. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 190, May 30, 1930, pages 303–312.

After consideration of the theory of reflective power of Fe-C alloys, reflective power of pearlitic, martensite and Ledebur structures as a function of C contents, changing reflective power by heat treatment, the color of Fe-C alloys is concluded to be independent of the C content and the intensity of the color to be the differing quality. The designs developed by the polishing of Japanese swords are explained by the variation in the composition of the surface. (12m)

The Coloring of Cadmium. HUGO KRAUSE. *Metal Industry* (London), Vol. 37, July 25, 1930, pages 79–82; Aug. 1, 1930, page 109; *Metal Industry* (N. Y.), Vol. 28, Sept. 1930, pages 424–426; Oct., pages 475–477.

Translated from *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle*, Vol. 3, pages 45, 56, 72 (1929), and Vol. 4, page 16 (1930). Experiments were carried out to determine which coloring methods available for other metals are applicable to Cd and what new processes of serviceable colored Cd finishes are to be achieved. Formation of CdO is particularly suitable for coloring this metal. An equally valuable compound is CdS. Halogen compounds cannot be considered as finishes. Results with chlorate solutions are given. Buchner recommends for Zn coloring a number of solutions whose action depends on separation of Cu by the dissolution of Zn and the conversion of the Cu film into Cu_2O or CuO and Cu_2Cl_2. The Czochralski black coloring method for Al consists in treating with ammoniacal CO solution and strongly heating. The permanganate bath is used in many varied compositions. The brown coloring processes tested were the Ebermayer, Buchner and the Japanese. Special methods for tinting Cd deposits. The permanganate-cadium nitrate baths can vary between wide limits. VSP(12m)

DEFECTS (13)

The Notch-Danger. (Ueber die Kerbgefahr.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 71–77.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. (13)

The Failure of Flat Bottom Steel Rails. A. H. HUDDART (Egyptian State Railways). *Engineer*, Vol. 150, Dec. 12, 1930, page 650.

Discusses tests made to determine cause of failure by fracture of a large number of steel rails manufactured for the Egyptian State Railways. Failure occurred within one year of date of rolling. Table shows figures obtained by typical works tests and by hardness tests. Results show that "chilling" in rails of high Mn and C content is cause of fracture. Recommends control of cooling rate after rail leaves mill to obtain ideal combination of strength and hardness. Suggests that perfectly sound rail to give good track service will show higher degree of hardness in the "as rolled" state than in the "normalized" state. LFM(13)

Modern Billet Chipping Practice. ROBERT S. HAYDOCK & CARL LINDEN (Cincinnati Planer Co.). *Rolling Mill Journal*, Vol. 3, Dec. 1929, pages 511–514.

From paper read before the American Society of Mechanical Engineers in Akron, Ohio. Outlines various methods of chipping billets and describes types of milling, deseaming, and planing machines used. MS(13)

Transverse Fissures in Rails; Their Cause and Prevention. J. E. HOWARD. *Engineering News Record*, Vol. 103, Dec. 12, 1929, page 927.

Abstract of a report by the engineer-physicist of the Interstate Commerce Commission states that transverse fissures in rails are caused by excessive wheel loads, and that the remedy lies in finding some grade of steel which will best endure strains. (13)

Red-Shortness. (Ueber Rotbruch.) F. HARTLANEK. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 207–214; *Stahl und Eisen*, Vol. 50, Nov. 20, page 1646

A charge of Mn scrap (1.7% to 1.8% Mn) was melted in a 300 kg. Heroult furnace and subjected to an ore oxidation succeeded by deoxidation with C. The whole course of the melting process was divided into an oxidation and a deoxidation period. After each of the 2 periods, deoxidation was accomplished by Al or Si or Mn. At the end of the oxidation period, the steel was to a large extent interspersed with inclusions. At the beginning of the introduction of C, the amount of inclusions decreased. They practically disappeared completely after some time but increased again at the end of the deoxidation period. The samples taken during the oxidation period show the tendency toward red-shortness at 1000° C., 1100° C. and 1300° C., but less pronounced at 1200° C. and 1250° C. The samples taken during the deoxidation period behaved differently, showing an increase of red-hortness with increasing temperature up to 1300° C. The temperature of most pronounced red-shortness decreases with decreasing C content. The tests indicate that there are 2 distinct temperature ranges of red-shortness which, according to Niedenthal's terminology are suitably called red-shortness in the lower temperature range and hot-shortness for the higher temperature range. The cause of blue-brittleness is traced back to oxidic inclusions. The cause of hot-shortness is seen in the influence of gases present. GN(13)

CHEMICAL ANALYSIS (14)

The Separation of Bismuth from Lead Containing Materials as BiOCl. (Bi-Trennungen von bleihaltigen Materialen als BiOCl.) W. HERTEL. *Metall und Erz*, Vol. 27, Nov. 1930, pages 557–560

Contains 2 references. For quick and accurate results the separation of Bi as BiOCl is better than the sulphate method. With 2 to 50 g. samples the volume of the solution can be kept down to 500 cc. The sample is dissolved in dilute HNO_3, neutralized with NH_4OH until Pb begins to precipitate, the Pb redissolved with dilute HCl and 1–3 cc. excess added. After heating, BiOCl is allowed to settle and filtered off. The precipitate is dissolved in 1:1 HCl, H_2SO_4 added and boiled to fumes of SO_3. After diluting Pb, if present, is filtered off and Bi precipitated with NH_4OH and $(NH_4)_2CO_3$. Cu and Pb are determined in the first filtrate. If Sb is present, the sample is dissolved in HNO_3, Sp. Gr. 1.33, and without filtering, BiOCl is precipitated, filtered off and dissolved in 1:1 HCl, neutralized with NH_4OH and the Bi separated with Na_2S. Pb, Cu, Sn and Sb can be determined in the filtrates. CEM(14)

A Method for the Separation of Lead and Bismuth. (Ueber ein Verfahren für die Trennung von Blei und Wismut.) H. BLUMENTHAL. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 13, 1930, pages 140–142.

See *Metals & Alloys*, Vol. 1, March 1930, page 431. (14)

New Reagent for the Qualitative and Quantitative Determination of Copper. (Ueber ein neues Reagens zur Qualitativen und Quantitativen Bestimmung des Kupfers.) FRITZ EPHRAIM. *Berichte der deutschen Chemischen Gesellschaft*, Vol. 63, Sept. 17, 1930, pages 1928–1930.

3 references. Cu can be precipitated quantitatively from acid solution by salicylaldoxim in the presence of any other metal. The greenish-yellow precipitate has the formula $(C_7H_6O_2N)_2$ Cu. The salicylaldoxim salts of all other metals are soluble in acid. The Cu solution is treated with NaOH until a precipitate begins to form, is acidified with acetic acid and the reagent is added at room temperature. The precipitate is filtered in a porous porcelain crucible, washed and dried at 100–105° C. It should not be heated above 115° C. It contains 18.95% Cu. CEM(14)

ECONOMIC (16)

Operation of an Open-Hearth Steel Plant with the Aid of Time-Contracts. (Die Betriebsführung im Siemens-Martin-Werk mit Hilfe von Zeitgedingen.) O. CROMBERG. *Archiv für Eisenhüttenwesen*, Vol. 3, June 1930, pages 731–744; *Stahl und Eisen*, Vol. 50, July 1930, page 996.

A scheme is described in detail by which the wages of all employees in an open-hearth steel plant are based on the daily production. GN(16)

The Possibilities and Prospects for the Utilization of Canadian-Produced Copper in Home Manufacturing Industries. A. H. A. ROBINSON (Canadian Dept. of Mines, Mines Branch) & W. H. LOSEE (Dominion Bureau of Statistics). *Canadian Mining & Metallurgical Bulletin* No. 225, Jan. 1931, pages 149–184.

Canadian mines formerly exported as ore, matte, blister, etc., almost all the copper produced, forcing the manufacturers to import refined metal. The present movement of Canadian copper is traced and the history of Canadian refining developed. Exhaustive tables of imports and exports are given. The tariff on copper and its products entering Canada, United Kingdom, United States, Argentina, Brazil, Mexico, Belgium, France, Germany, Italy, Switzerland, Japan and China is tabularly presented. AHE(16)

Can Silver Come Back? W. F BOERICKE *Mining & Metallurgy*, Vol. 11, April 1930, pages 207–209.

A brief analysis of present demand and inquiry into stimulation of industrial uses. There was an increase in production from 1923 to 1928 amounting to 7.4% with slight falling off in 1929. For 1927 the average quotation was 56.37 cents, 58.17 in 1928 and 53.0 in 1929. In the U. S. and Canada 37 million ounces were used in 1929 in manufacture of silverware, silver plate, photography, etc. Demand for silver depends largely on economic conditions in the Far East. Domestic demand for silver appears insufficient. Production is over 60 million ounces and consumption only 39 million ounces. Main source of domestic demand comes from silverware manufacturers, photography film makers and chemical trade. Price reduction would have doubtful benefits. A real silver research program is needed. VSP(16)

The Present Radium Situation. R. B. MOORE (Purdue Univ.). *Mining & Metallurgy*, Vol. 11, Feb. 1930, pages 91–92.

Read before Rare Metals and Minerals Committee of the American Institute of Mining and Metallurgical Engineers, Feb. 1930. In 1914 the total amount of radium in the world was about 10 g. During early years of operation in this country the average grade of carnotite ore was about $2^1/_2$% and 3% U_3O_3. Torbenite and autunite have been found in South Australia. Uraninite and allanite found in Canada. Original mines in Czecho Slovakia are still productive. The real demand for radium is for cancer treatment. Much progress has been made in radium treatment of cancer. Considers cost of production and world output. VSP(16)

World Reserves of Tin and United States Consumption. *Information Circular* 6249, *United States Bureau of Mines*, Aug. 1930, pages 654, 673.

40% of the world virgin Sn is consumed in the U. S. and 99% of that domestically is imported. There are no domestic resources except scrap. Production of Sn from various sources for 1928 is given. ESC(16)

World Iron Ore Supply Apparently is Without Limit. CHARLES HART (Delaware River Steel Co.). *Iron Trade Review*, Vol. 86, April 10, 1930, pages 63–64.

Abstract of an elaborate paper on world's iron ore resources. On the basis of the researches of the foremost geologists, the addition of discoveries since their reports were made, and the deduction of the amount of ore consumed, it is estimated that actual and potential reserves at present are approximately: North America, 114 $\times$ 10^9 tons; South America, 8349 $\times$ 10^6 tons; Europe, 29 $\times$ 10^9 tons; Asia, 22 $\times$ 10^9 tons; Australia and New Zealand 991 $\times$ 10^6 tons; and Africa, 15 $\times$ 10^7 tons. The total is about 175 $\times$ 10^9 tons. MS(16)

Iron Ore Industry Speeds Up. A J. HAIN. *Iron Trade Review*, Vol. 86, Jan. 2, 1930, pages 32–35, 69.

Survey of the industry for 1929. Lake Superior mines were more active than in any year since the war. Leading companies sought to increase their reserves. Total ore shipments from region were 66,150,600 tons. MS(16)

Eight Operators Ship 89 Per Cent of Lake Superior Iron Ore. A. J. HAIN. *Iron Trade Review*, Vol. 86, Jan. 30, 1930, pages 55–57, 60.

Statistical survey of the Lake Superior iron ore industry. MS(16)

The Growth of the Steel Industry in Japan. (Entwicklung der Stahlindustrie in Japan.) H. FEY. *Stahl und Eisen*, Vol. 50, May 1, 1930, pages 598–601.

The author gives a summary of 4 papers presented at the World Engineering Congress at Tokio, 1929, which deals with the rise of the Japanese steel industry. The statistics given refer to the more important iron and steel works, the production of pig iron from 1914 to 1928, the composition of Japanese ores, iron as well as manganese ores, composition of coal and coke, the composition of pig iron and dimensions of blast furnaces of the more important plants. GN(16)

Silver, Copper, Lead, and Zinc in the Central States in 1929. J. P. DUNLOP & H. M. MEYER. *Mineral Resources of the United States*, 1929, Part I, *United States Bureau of Mines*, Jan. 10, 1931, pages 143–177,.

The mines of Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin produced $110,979,243 worth of silver, copper, lead and zinc in 1929, an increase of about 16% over 1928. Other than silver which decreased about 4.7% in value, both the quantity and value of each of these metals increased over 1928, silver about 4.6% in amount, copper about 4.4% in quantity and about 28% in value, lead about 2.8% in quantity and about 11.6% in value, and zinc about 3.4% in quantity and about 11.9% in value. Copper production was all from Michigan except about 1 ton from Missouri. Missouri produced 73% of the lead. AHE(16)

The Iron and Steel Industry Since the War. M. S. BIRKETT. *Foundry Trade Journal*, Vol. 42, Apr. 3, 1930, pages 250–252; April 10, 1930, pages 264–265.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 803. (16)

Sources and Application of Chromium. LEWIS A. SMITH. *Heat Treating & Forging*, Vol. 16, March 1930, pages 343–344.

From a publication of the United States Bureau of Mines. See *Metals & Alloys*, Vol. 1, June 1930, page 570. MS(16)

Belgian Iron and Steel Industry, 1928. *Iron & Coal Trades Review*, Vol. 121, July 25, 1930, page 117.

Abstract of an official report. Includes statistics on production of ore, production of various types of steel and steel products, number of men employed, and amount of coal and coke consumed. RHP(16)

Economic Conditions in Turkey. *Iron & Coal Trades Review*, Vol. 121, Aug. 8, 1930, page 187.

Abstract of part of a report by Col. H. Woods issued by the (British) Dept. of Overseas Trade. Turkey is an important market for structural steel. Recent demand is lower due to use of reinforced concrete. Discusses imports and various uses of steel. RHP(16)

FOUNDRY PRACTICE & APPLIANCES (22)

Sand Control in the Steel Foundry. H. D. PHILLIPS. *Metals & Alloys*, Vol. 1, Oct. 1930, pages 759–762.

The moisture in molding sand should be so controlled as to allow proper molding and to avoid spraying of the sand after it is in the flasks which would naturally result in localized wet and impermeable spots. The permeability of the heap or backing sand should be greater than that of the facing sand. The compressive strength in lbs./in.^{2} should be great enough to allow quick and proper molding, without which it is possible that the sand may weaken and collapse. The grain size of the sand should be adjusted to give the desired surface on the casting. The silt, fines, and active bond should be held under 10%. ESC(22)

Application of Brass Ingot Metal in Industry. WILLIAM ROMANOFF & C. O. THIEME (H. Kramer & Co.). *Metal Industry* (N. Y.), Vol. 28, July 1930, pages 334–335, *American Metal Market*, Vol. 37, July 3, 1930 pages 3, 10.

From a paper read before the Cleveland Meeting of the American Foundrymen's Association, May 12–16, 1930. States that just as good results can be obtained from ingot as from virgin metal, and that it is more "fool proof" in its use in addition to effecting a saving. The metal may be remelted any number of times without deleterious results. VSP(22)

Shows Penetration of Steel Cast Against Sand. S. L. GOODALE. *Foundry*, Vol. 58, Aug. 1, 1930, pages 93–94.

Results of investigation of the action of molten steel in the sand mold. An abstract of paper presented before the 1930 convention of American Foundrymen's Association held in Cleveland. VSP(22)

A New Method of Making High Test Cast Iron, Chilled Casting, Malleable Iron and Steel in the Cupola. (Neuer Weg zur Erzeugung von Qualitäts-Grauguss-Hartguss-Temperguss und Flussstahl im Kupolofen.) LAMLA. *Giesserei Zeitung*, Vol. 27, Nov. 15, 1930, pages 621–623.

A new type of melting furnace is described which combines a cupola with an open hearth furnace. GN(22)

Separation and Cleaning Operations in Foundries. (Trenn- und Reinigungsarbeiten in der Giesserei.) M. KURREIN. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 382–386.

Reviews the present state of treating of non-ferrous metals and alloys in foundry work by chisel, countersink-drill, saw and grinding operations as well as by sand blast. EF(22)

The Reclamation of Oil-Sand Cores. FRANK HUDSON (Fordath Engineering Co., Ltd.). *Foundry Trade Journal*, Vol. 43, July 24, 1930, pages 56–58; July 31, pages 78–80.

Paper read before the Institute of British Foundrymen. Considerable thought has been given to the problem, but successful application has still to come. Gives consensus of opinion existing in the United States relative to reclamation of oil-sand cores. Very little oil-sand core reclamation is practical in British Foundries. Benefits arising through reclamation of core sand must be considered individually by each foundry according to their particular practice. Points to be considered are: (1) Initial cost of core sand; (2) amount of oil-sand core used; (3) cost and kind of binder used; (4) nature of metal used for casting; (5) cost of disposal of waste sand; and (6) existing plant layout and type of castings made. Through reclamation a uniform sand free from gas and saving in binder costs is obtained. Effect of casting temperature on core sands in regard to splitting up of sand grains is important. Practical reclamation methods are discussed. For grading, the electric vibrating type of screen is used. VSP(22)

Using Off Peak Power for Melting Gray Iron. W. R. JENNINGS. *Metals & Alloys*, Vol. 1, Nov. 1930, pages 814–815.

The Baker Perkins Co. of Saginaw, Michigan, is operating a rocking type of electric furnace for converting iron borings into high strength irons. Since the increased demand charge would require a cost of $9.44 to $10.03 per net ton, the operation time was changed to the hours of 4:00 to 12:00 P. M. and a saving of $5500 per year results. ESC(22)

Mechanical Cupola Charging. CLEMENT A. HARDY (Whiting Corp.). *Iron Age*, Vol. 125, Nov. 6, 1930, pages 1306–1308.

Describes several forms of machines for better distribution of charge such as side-dump charges, bottom-dump cars, skid hoists and other devices manufactured by the Whiting Corporation. VSP(22)

Britain's Bell Foundries. Notes on the Present State of Ancient Craft. J. R. NICHOLS. *Metal Industry* (London), Vol. 36, June 6, 1930, pages 597–600; June 13, 1930, pages 621–623; Vol. 37, July 4, 1930, pages 3–5.

Gives a description of bell founding and some famous British foundries. VSP(22)

Oil Sand Cores Used in Casting Alloy Steel Chains. J. C. PENDELTON. *Foundry*, Vol. 58, June 1, 1930, pages 159–162.

Describes manufacture of chains as practiced at the Norfolk Navy Yard to meet navy specifications. Following physical requirements are needed: tensile strength 100,000 lbs./in.^{2}; yield point 60% of ultimate tensile strength; reduction area 18% and elongation in 2 in., 10%. All above requirements are minimum. Chains are cast in dried oil sand molds and consist of 2 operations. Pattern work is in form of core boxes. Test chains are heat treated at same time and same furnace as chain shots which they represent. VSP(22)

On the Fundamental Study for the Production of Low Carbon Semi-steels from the Stand Point of Cupola Operations. (Part 2.) MASAYASU HORIKIRI. *Tetsu to Hagane*, Vol. 16, Sept. 25, 1930, pages 935–960; Oct. 25, 1930, pages 1063–1086.

In the present paper, the writer reports the result of an investigation on the production of low C semi-steels on a large scale. As materials, pig Fe and mild steel scrap were used and melted together in a large cupola, 900 mm. in the diameter at the melting zone. The temperature in the inner part was measured. The combustion gas at that place was taken and CO_2, CO and O_2 were determined. The results thus obtained clearly showed that the C in semi-steels is absorbed by contact of red-hot coke with the molten Fe. It is, therefore, necessary to use the minimum quantity of charged coke and to reduce the oxides in the charge with Si in order to obtain the low C semi-steels. Moreover, the molten Fe containing high Si dissolves only a small amount of C, so that high grade low C semi-steels, generally, contain much Si. After the experiments under the several conditions at the melting zone, the writer concluded that the oxidation of Fe by gases gradually decreases from the tuyère level to the upper part, and increases on approaching the furnace wall but decreases at the center part. The relation between the depth of the cupola hearth and the C absorption of molten Fe was studied and it is shown that there are no remarkable relations between the m. When many tuyères with small sectional area are used and the blast is passed through at high speed, the conditions are satisfactory, the atmosphere in the melting zone being oxidizing and considerable C absorbed by the melt. On the other hand, with large sectional area and small numbers of tuyères the atmosphere is reducing and the absorption of C decreases. The C content in the product depends on the contact condition of the gases with the melt and red-hot coke at the melting zone, that is, the oxidation takes place by the gases, according to the following: $2Fe + O_2 \longrightarrow 2FeO$, or $Fe + CO_2 = FeO + CO$, and the reducing by the red-hot coke, thus: $FeO + C = Fe + CO$, $2FeO + Si = Fe + SiO_2$ and $SiO_2 + C = Si + CO_2$. TS(22)

Steel Castings. T. M. SERVICE. *Foundry Trade Journal*, Vol. 42, April 10, 1930, pages 266–268; April 17, 1930, pages 291–292; Discussion, May 1, 1930, pages 323–324.

Paper read before the Scottish Section of the Institute of British Foundrymen. Steel when cooling evolves gas, contracts in volume, contracts superficially and several of its constituents segregate. Defects found in castings are: (1) blowholes; (2) piping; (3) hot tears and tension cracks; and (4) segregates. Al is added to steel to reduce blowholes. Blowholes may be of three types: (*a*) Completely dispersed through mass; (*b*) Blowholes occurring below the skin surface and extending from 1/8 to 1/2 in. deep. Recent determination of density of steel at temperature 1480–1500° C. is given as 7.0. Loss due to excess metal required for heads varies between 30 to 40%. Superficial contraction was determined in acid and basic steel. Composition:

	C	Si	Mn	S	P
Acid	0.28–0.50	0.22–0.60	0.26–0.60	0.036–0.085	0.063–1.106
Basic	0.15–0.39	0.32–0.47	0.49–1.80	0.021–0.045	0.014–0.047

Hot tears are due to excessive stress applied in the plastic range. Tension cracks occur in castings which have a rapid change of section. Cracking takes place generally at about 100° to 300° C. Gives a number of tables and illustrations. VSP(22)

Modern Core-Making Practice. C. WOOD. *Foundry Trade Journal*, Vol. 42, April 24, 1930, pages 304–306.

Paper read before the Sheffield branch of the Institute of British Foundrymen. Cores are used to provide holes, recesses and openings in finished castings. Gases formed in mold pass out through these cores and not through the metal. Points to be considered in core production are: (1) Class and density of sand used; (2) bond of the sand; (3) weight and size of core; (4) thickness and general contour of the casting for which it is used; and (5) drying temperature of core. New type of machine now on the market is known as a perfect core machine, by which all types of cores can be made. It will permit the use of interchangeable core boxes. Suitable for making round, half-round, chamber, square and similar shaped cores. Any mixture of sand may be used. Sands for core making must possess cohesion and strength. The best known binder is linseed oil. Slow drying of cores, with efficient and complete temperature control, results in improved cores. Temperatures of from 225° to 265° C. are used for sections to 2 in. thick and 200° to 220° C. for sections heavier than 2 in. thick. Considers oil sand practice and methods for testing sands. VSP(22)

Cast Iron Research and Foundry Practice. (Gusseisenforschung und Giessereipraxis.) LOHSE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, July 5, 1930, page 944.

Report on some of the papers read before the Convention of the Verein deutscher Giessereifachleute. Osann shows that high-grade cast-iron is the same as eutectic cast iron; this iron possesses good flowability, little tendency to form pipes and good workability. Foundries should, therefore, aim to produce eutectic cast-iron by proper proportioning of the contents of carbon and silicon. F. Roll discussed the hardness of cast-iron as dependent on temperature and the fairly complex relations between hardness, carbon content, temperature and time. Bardenheuer reported on recent results of American research of the physical properties of cast-iron for which a classification according to the content of carbon and silicon has been proposed. Ha (22)

Long-Life Molds and Their Uses. RICHARD MOLDENKE. *Iron Age*, Vol. 125, May 1, 1930, pages 1292–1293.

No material of construction known, which serving as a container for molten metal, will not eventually break down under the extremely high temperatures. "Permanent" mold is a misnomer; "Long-life" is preferable. Molten metal coming in contact with sand or metal mold surfaces has a two-fold effect: (1) Washing away of such surfaces in part, and (2) destruction of surfaces due to high temperatures and consequent penetration of metal. Metal molds with refractory coatings are the most promising development. Most refractory material for long-life molds is gas carbon. VSP(22)

Duplexing with Cupola Makes High-Grade Iron Castings. H. E. BROMER (Standard Foundry Co.). *Iron Age*, Vol. 125, May 8, 1930, pages 1372–1376.

Describes method employed by the Standard Foundry Co. The cupola, a standard No. 7 Whiting, is charged in same way and with same materials as formerly, with the exception that coke was cut to 135 lb. to the ton. After about 8 or 10 min. the first iron starts coming over the spout. This runs directly into the electric furnace and remains there without power until two taps have been run in. The bath is brought to a temperature of about 3000° F. The advantages of the electric process are the uniformity and quality of the iron produced. Test bars show a transverse test of 4800 lbs. with a deflection of 0.13 in. Tensile tests showed an average strength of 40,000 lbs./in.^{2} Alloy irons also produced. Impact values obtained for plain iron are approximately twice as high as for the cupola product. Brinell hardness is practically the same throughout the casting. Costs are materially lowered. VSP(22)

Malleable Cast Iron, Part 3, Comparison of Melting Practices. J. V. MURRAY. *Metallurgia*, Vol. 2, July 1930, pages 101–102; Part 4, Oct. 1930, pages 215–217.

Discusses various furnaces used in melting malleable iron. The cupola is fast and satisfactory when everything is working right. The crucible process is only satisfactory for experimental work and for producing very small castings. The open-hearth furnace produces a good metal, but at a high cost. Electric furnaces, particularly the induction furnace, have cost as their only disadvantage. The rotary furnace has recently been introduced, and is a good, cheap melting furnace. Several duplex processes are mentioned. JLG(22)

The Fundamentals of Brass Foundry Practice. Part 23. R. R. CLARKE. *Metal Industry* (N. Y.), Vol. 28, May 1930, pages 221–222.

Two main difficulties attend Cu molding: (1) High and local shrinkage; (2) obtaining clean metal free of scum and dross of the metal's own making. Oxidation and gasification are very prominent in Cu. Overcoming them, and where electrical conductivity requirements are not high, 2% Zn and trace of P are added. Addition of Mg to Cu does not interfere much with conductivity. Describes method of molding. VSP(22)

A Special Bronze Casting Problem. JOSEPH P. MCGINNIS (E. R. Caldwell & Sons Co.). *Metal Industry* (N. Y.), Vol. 28, May 1930, pages 212–213.

Describes the molding of a hub disc for a 3 in. slurry pump made for the Morris Machine Works, Baldwinsville, N. Y. VSP(22)

Foundry Problems. H. HURST. *Foundry Trade Journal*, Vol. 42, April 24, 1930, pages 312–313.

Paper read before Scottish Branch of the Institute of British Foundrymen. Deals with foundry organization rather than making of any special castings. Takes up the following features: the type of work; situation of works; hand or machine molding; foundry personnel; staff and ordinary labor; type and quality of patterns; melting equipment; sand preparation plant; corestoves; and commercial end of the business. VSP(22)

Building a Mould in Sections for a Machine Base. J. BENNETT. *Foundry Trade Journal*, Vol. 42, May 1, 1930, pages 330–332.

Includes discussion. Paper read before the Wales and Monmouthshire Branch of the Institute of British Foundrymen. Describes methods employed in the construction of the mold. Gives a number of illustrations. VSP(22)

FURNACES & FUELS (23)

Electric Resistance Industrial Furnaces. VICTOR PASCHKIS. *Heat Treating & Forging*, Vol. 16, March 1930, pages 376–380.

Translated from *Stahl und Eisen*. MS(23)

Gas Modernizes Forging. C. B. PHILLIPS (Surface Combustion Co.). *American Gas Journal*, Vol. 132, Apr. 1930, pages 73–74.

Description of a furnace known as continuous billet-heating furnace which is of the double-row type, using 2 pneumatic pushers. It is 24 1/2 ft. long, 6 ft. wide and about 20 in. high from skid rails to spring line of arch, internal dimensions; of brick construction, the whole is encased in steel plates and supported by buck stays; the walls are 13 1/2 in. thick and consist of 9 in. of firebrick and 4 1/2 in. of insulation. Low-pressure gas is used and there are 8 water-cooled burners. (23)

The Coreless Induction Furnace in a New Role. A. G. ROBIETTE. *Iron & Steel Industry & British Foundryman*, Vol. 4, Jan. 1931, pages 125–129.

Experiments were made to determine the possibilities of refining low-grade steel scrap of various compositions and of pig irons, the extent of the elimination of the elements silicon, manganese, phosphorus, carbon and sulphur under varying conditions, and the speed of elimination. Silicon is removed as rapidly as ore is charged. Dephosphorization is rapid and quite complete under suitable slag conditions. Carbon removal is rapid in both the slag reaction process and the air blast method. Sulphur removal is generally erratic, it increases with the fluorspar addition. Products of deoxidation are removed in a few seconds through rapid circulatory motion of the charge. An auxilliary arc above slag surface to keep it fluid is suggested. CHL(23)

Factors Influencing the Design of Normalising Furnaces. E. E. GRIFFITHS. *Metallurgia*, Vol. 3, Dec. 1930, pages 62–64 and 68; *Iron & Coal Trades Review*, Vol. 121, Dec. 5, 1930, pages 835–837.

Lengthy abstract of paper before Wales branch of the Institute of Mechanical Engineers. Considers furnaces for normalizing sheet and tin-plate. JLG(23)

Developments in Sheet Mill Practice. EDWARD S. LAWRENCE. *Blast Furnace & Steel Plant*, Vol. 18, Aug. 1930, pages 1301–1302, 1306; Sept. 1930, pages 1455–1460.

Review of recent United States patents on continuous pair and pack furnaces, rolling-mill equipment, normalizing and annealing furnaces, pickling machines and annealing-boxes. MS(23)

REFRACTORIES & FURNACE MATERIALS (24)

Development of Modern Refractories. H. E. WHITE. *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 107–110.

Presents brief review of the first crude refractories of ancient times and the development of alumina, silicon carbide, and mullite refractories and graphite crucibles. MS(24)

Testing Refractory Cements. CHARLES MCMULLEN. *Fuels & Furnaces*, Vol. 8, March 1930, pages 358–359.

Abstract of paper read before the American Ceramic Society, Feb. 16–21, 1930. Developed a small test furnace, heated electrically with "Globar" non-metallic resistor heating elements, which attains a maximum temperature of 1500° C. Includes transverse and load testing equipment. Tests were made by: (1) Heating test bar to temperatures, holding for 4 hrs., then breaking (transverse) at this temperature; (2) same as (1), except that bar is broken cold; and (3) heating bar to temperature, holding for 5 min., and breaking at this temperature. Test (1) gives strength of cement after it is in use at a certain temperature; test (2) gives strength after cooling; and test (3) gives strength on initial firing in use. Presents results obtained with a high-grade commercial cement. MS(24)

Refractories for Open-Hearth Furnaces. *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 999–1001.

Discusses materials and construction that are most satisfactory. Checker chambers are usually built of a good grade of fire-brick and these should be used throughout the flues to the stack. Chambers should be insulated with 4 1/2 in. of insulating brick. Fantail arches of furnaces should be installed with clay brick and covered well. Silica brick should be used to support the fantails. Clay brick are generally used in the walls of slag pockets to about the height of the slag line, and silica brick from this point up to the roof of the furnace. Chrome brick are being used to a great extent in gas-port linings. In the last 10 years chrome brick have replaced magnesite brick for bottom, though many operators still use the latter. Furnace crowns do not run the full life of the furnace. Rib roofs and heavy construction are used to prolong the life of crowns. MS(24)

Refractory Materials. COLIN PRESSWOOD. *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 838–840.

From *Metallurgia*, Nov. 1929. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 684. MS(24)

Silicon Carbide and Mullite. HAROLD E. WHITE (Lava Crucible Co.). *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 840, 842.

From *Mining & Metallurgy*. MS(24)

Study of Checker Brick. R. M. KING (Ohio State University). *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 837–838.

Paper read before the American Ceramic Society, Feb. 1930. Progress report. Presents results of a laboratory investigation of the porosity, P. C. E. values, heat transfer, and uniformity of dimensions of 10 1/2 × 4 1/2 × 4 1/2 in. and 9 × 4 1/2 × 2 1/2 in. brick. Tests were carried out on bricks from Ohio, Pennsylvania, Kentucky, and Missouri, and made by the soft-mud, stiff-mud, and dry-press processes. MS(24)

Metallurgical Refractories. *Iron & Coal Trades Review*. Vol. 121, Aug. 1, 1930, page 160.

Practically the same as the article by H. E. Townsend entitled "Refractory Brick and its Manufacture," published in *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 105, 195–196. Also published in *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 193–195. RHP(24)

Refractories. R. M. DOIDGE (Morgan Crucible Co., Ltd.). *Blast Furnace & Steel Plant*, Vol. 17, Dec. 1929, pages 1854, 1857–1858; Vol. 18, Feb. 1920, pages 345–346, 349–350; Condensed in *Heat Treating & Forging*, Vol. 15, Dec. 1929, page 1632; Vol. 16, Jan. 1930, page 112.

Paper read before the Swansea Section of the Institute of Metals. Discusses the causes of the premature failures of refractories and the means of overcoming them. Chief causes are lack of refractoriness; shrinkage or expansion in use; softening under load; mechanical erosion or breakage; cracking or spalling; and erosion by slags or fluxes. Deals briefly with refractories for special uses. MS(24)

Increasing the Life of Furnace Brick Work. *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 1011–1012.

Walls may be repaired with a refractory mixture made of pulverized clean brick salvaged from dismantled furnaces and a suitable bonding material. This is mixed with H_2O and applied to the furnace linings by means of a cement gun. The factor which requires the most careful investigation is the constituency of the mixture to be used in various types of furnaces and under various conditions. Discusses several batches. MS(24)

GASES IN METALS (25)

Influence of Nitrogen in Electric Arc Fusion-Welding. (Einfluss des Stickstoffs bei der elektrischen Lichtbogen-Schmelzschweissung.) JULIUS FUCHS. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1569–1572.

The following table illustrates the results of tests to find the harmful influence of N on welded seams. The type of electrode is of great importance; the better it is covered, the less N is absorbed.

Sample No.	Type of electrode	Burning depth mm.	Brinell hardness kg./mm.²	Nitrogen contents %	Quality of weld
1		1.6	67.8	0.048	
1	Thickly	2.0	64	0.034	Forgeable
2	covered	2.2	56	0.054	
2		2.5	54	0.060	
3		2.0	64	0.064	
3	Asbestos	2.3	64	0.070	Forgeable
4	covered	2.3	64	0.058	
4		2.5	61.5	0.054	
5		1.9	59	0.075	
5		2.0	61	0.080	
6	Bare, with	2.4	62	0.103	Forgeable
6	non-	2.4	59	0.105	
7	metallic	2.0	56.5	0.097	
7	core	1.9	51.8	0.090	
8	Dipped	2.1	59	0.129	Not forgeable
8		2.2	71.2	0.150	
9	Charcoal	2.1	71.2	0.149	Not forgeable
9	wire	1.5	61.5	0.130	
10	Thinly	2.2	71.2	0.150	Not forgeable
11	covered	2.7	64.3	0.129	

For high-grade welds, i. e., all connection welds, the forgeability should also be taken into account in order to avoid inclination to fractures. Ha(25)

Causes of Unsoundness in Bronze Castings. J. DANIELS. *Fuels & Furnaces*, Vol. 8, May 1930, pages 627–630; *Journal of Institute of Metals*, Vol. 43(1930) pages 125–162.

From paper read before Institute of Metals. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. MS(25)

Adsorption of Hydrogen by Nickel at Low Temperatures. ARTHUR F. BENTON & T. A. WHITE. *Journal American Chemical Society*, Vol. 52, June 1930, pages 2325–2336.

Presented before the Division of Physical and Inorganic Chemistry at the Columbus Meeting of the American Chemical Society, April 1929. At a given pressure the adsorption is relatively large at the lowest temperatures, decreases to a minimum at −200° to −175° C. depending on the pressure, then rises to a maximum at about −100, and finally decreases again at higher temperatures. At 600 mm. the adsorption is independent of the temperature from −100° to 0°. At −191° and −183° the adsorption increases with pressure in a discontinuous manner. Interpretations are made as to the type of adsorption at high and low temperatures. MEH(25)

The Occurrence and Determination of Gases in Metals. JULIUS GRANT. *Metal Industry* (London), Vol. 37, Sept. 26, 1930, page 292.

Cites researches of a number of investigators and briefly discusses the results of their work. VSP(25)

Treating Aluminum Alloys with Volatile Chlorides. W. ROSENHAIN, J. D. GROGAN & T. H. SCHOFIELD. *Iron Age*, Vol. 126, Oct. 9, 1930, page 985.

Abstract of paper read before the Institute of Metals. See "Gas Removal and Grain Refinement of Aluminium Alloys," *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. VSP(25)

Solubility of Oxygen in Solid Iron. (Löslichkeit des Sauerstoffs in festem Eisen.) W. BISCHOF. *Stahl und Eisen*, Vol. 50, Jan. 2, 1930, pages 18–19.

The author reviews the 8th installment of R. Schenk's and his collaborator's investigations on the reduction, oxidation and carburization process for Fe as published in the *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 182, 1929, pages 94–117. Reference is also made to an investigation by W. Krings and J. Kempkens on the same subject, published in the *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 183, 1929, pages 225–250. The results of both investigations are in much better agreement with the general opinion on the solubility of O in solid Fe than former investigations. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 17. GN(25)

INSPECTION (26)

Hot Acid Test for Tool Steel. *Heat Treating & Forging*, Vol. 16, June 1930, pages 747–749.

From a bulletin issued by the Research Department, Carpenter Steel Company. See editorial, "A New Era in Advertising," *Metals & Alloys*, Vol. 1, July 1930, page 587. MS(26)

Metal Pellets, Produced by Spark Tests, Used to Identify Alloy Steels. WALTER G. HILDORF & C. H. MCCOLLAM (Timken Roller Bearing Co.). *Iron Age*, Vol. 126, July 3, 1930, pages 1–4.

A further elaboration of an article in *Iron Age*, Oct. 10, 1929. Pellet test for alloy steel indentification gives valuable possibilities as an adjunct to spark test. Pellets are globules driven off by grinding wheels, but not affected by heat or chemical reaction. Method of separating pellets from turnings is given. Pellets from various alloys vary greatly in shape, texture and color of their surfaces. C content of plan C steels has but little effect on pellet characteristics. Cr makes pellets gray and round, alloys of Va group are very easily indentified by pellet test. The pellets are jet black and surfaces are heavily pitted, with somewhat polished appearance. Mo alloys offer an example of the interlocking of the spark and pellet tests. Mo spark characteristics are obscured but the pellet characteristics are easily distinguishable. Pellets from carburized steels show great accentuation of alloy characteristics. Preparation and use of standard pellet slides is essential. Table of comparative fields of spark and pellet tests in sorting alloys steels:

Steels	Spark Test	Pellet Test
1015 and 1095	Yes	No
4615 and 1095	Yes	No
1015 and 4615	Yes	No
1095 and 52100	Doubtful	Yes
1045 and 5145	Doubtful	Yes
6195 and 52100	Doubtful	Yes
6195 and 1095	Doubtful	Yes
4195 and 6195	Doubtful	Yes
4195 and 52100	Doubtful	Yes

VSP(26)

Specifications and Materials Control. H. A. BACKUS. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 109–118.

Discussion appended. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. (26)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

301 **Annealing Furnaces.**—The Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has just released a leaflet describing their rectangular and cylindrical bell type annealing furnaces. The advantages of these furnaces are close temperature control, controlled atmosphere and simplicity of operation.

302 **Die Casting Handbook.**—The object of this handbook is to supply general information to engineers who are already familiar with the die casting process. It contains data on the Stewart Die Casting Alloys. Stewart Die Casting Corporation, 4535 Fullerton Avenue, Chicago, Illinois.

303 **Nickel Alloy Steel Products.**—The International Nickel Company, Inc., 67 Wall Street, New York, N. Y., has published a 16-page Buyers Guide to these products, which is a tabulation of sources of supply for the more commonly used forged, rolled, cast or drawn products made from Nickel Steels and Alloys. This edition contains footnotes concerning the size ranges and production limitations of the various concerns listed.

304 **Electroplating Aluminum.**—This instructive booklet issued by the Aluminum Company of America, Pittsburgh, Pa., gives in great detail the method of plating aluminum using different deposits. Several plates and tables make the book even more complete.

305 **Inspection.**—An attractive and well-planned booklet issued by the Pittsburgh Testing Laboratory, Pittsburgh, Pa., brings out the value of careful inspection of materials used in all construction.

306 **Manganese Steel.**—The November issue of the Amsco Bulletin, issued by the American Manganese Steel Company, Chicago Heights, Ill., contains an interesting article on manganese steel sheaves as a means of saving rope as well as illustrations of manganese steel stone quarrying machine parts.

307 **Nirosta KA2 and KA4.**—The Associated Alloy Steel Company, Cleveland, Ohio, has printed three more pamphlets in their Technical Bulletin Series. These are: Resistance of Nirosta KA2 and KA4 against Chemical Attack, The Physical Properties of Nirosta KA2 and Fabrication of Nirosta.

308 **Plating Machines.**—Bulletin No. 313 is a very thorough discussion of the Meaker Straight-A-Way and Return Type Machines, indicating the economies effected by the use of this equipment. The Meaker Company, 1615 South 55th Avenue, Chicago, Illinois.

309 **Refractories.**—The E. J. Lavino and Company, Philadelphia, Pa., had a competent engineering firm survey their Plastic K-N and Kromepatch while in actual use. Copies of these surveys, LC-104-CZ, LC-109-AZ and LC-102-HZ, can be obtained upon request.

310 **Automatic Control.**—This booklet describes and illustrates how automatic control renders its aid as though it were humanly directing your process to meet changing operating conditions and requirements freeing the human element from its limitations. Brown Instrument Company, 4482 Wayne Ave., Philadelphia, Pa.

311 **Bearing Tester.**—This is a leaflet describing an acoustimeter for the inspection of ball and roller bearings. The function, operation and advantages of the Burgess Bearing Tester are also given. Burgess-Parr Company, 111 West Monroe St., Chicago, Ill.

312 **Pyrometers.**—Potentiometer pyrometers made by the Leeds & Northrup Company, Philadelphia, Pa., are accurate and well capable of withstanding rough service. They are described in a leaflet issued by the company.

313 **Refractories.**—A recent issue of *Grits & Grinds*, published by the Norton Company, Worcester, Mass., reprints an interesting article from Industrial Gas entitled "Alundum Refractories in Some Modern Gas Furnaces." A 16-page booklet issued by the company tells the whole story of the new Norton markings and "What is Controlled Structure?"

314 **Nickel Cast Iron.**—The December issue of this periodical published by the International Nickel Company, 67 Wall Street, New York, contains a brief history of cast iron, one of the series of Intimate Chats on Metallography and several important applications of nickel cast iron.

315 **Electrical Equipment.**—The General Electric Company, Schenectady, New York, has issued a number of new leaflets to be inserted in their GEA folder. These describe Resistor Arc Welders, Hand Starting Compensators, Fan-cooled Induction Motors, Magnetic Switches and Oil Circuit Breakers.

316 **Special Furnaces.**—A four-page folder sent out by the Surface Combustion Company, 2375 Dorr Street, Toledo, Ohio, describes an SC Car Bottom Annealing Furnace installed in the plant of the Link Belt Company.

◆ ◆ ◆

Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS OF METALS & ALLOYS

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These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class.
The remittance should accompany the order.
Book Reviews are included below and marked by -B-

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PATENT SERVICE

Until we resume regular publication in September, the service rendered by the Patent Department of METALS & ALLOYS will be carried on by Mr. W. M. Corse, 810 Eighteenth Street, Washington, D. C. who can supply copies of United States and foreign patents and translations at reasonable costs.

GENERAL (0)

Mitteilungen aus den Forschungsanstalten des G-H-H Konzerns. Published by V. D. I. Verlag, G. m. b. H., Berlin. Price about 2.50 RM per issue.

This new metallurgical journal had its first appearance in the fall of 1930. It is to contain articles from the testing laboratories of 11 German firms, headed by the Gutehoffnungshütte Oberhausen Aktiengesellschaft, including several machine shops and foundries, the Osnabrücker Kupfer und Drahtwerk, Eisenbahn Essen, etc. It carries no advertising.

The articles are apparently not to be of the highbrow type, recording the long and exact scientific laboratory work that we find in many German periodicals but are instead written from the works laboratory point of view, reflecting the attitude of the practical German metallurgist. Some of the articles read as though the author was letting off steam in defense of his own beliefs, and some approach being propaganda for the products of the firm from whose laboratory the article emanates.

The articles are interesting, but it may be well to recall the possibility that they may be written from the point of view of a man with an axe to grind.

The journal is to appear "every little while" (in zwangloser Folge).—H. W. Gillett (0)

Electro-motive Force and Polarisation. (Handbuch der allgemeinen Chemie. Elektromotorische Kräfte Elektrolyse und Polarisation.) Vol. 9, Part 1, of Ostwald-Drucker's Handbook of General Chemistry. R. Kremann & Robert Müller. Akademische Verlagsgesellschaft, Leipzig, 1930. Cloth 6¾ × 9½ inches, 891 pages. Price 85 RM.

This comprehensive reference book covers the theory of galvanic cells of all types and collects, in tables, about all the data available on the subject. It does not deal with fused salts, as electrolytes, but is complete as regards aqueous electrolytes and includes what data exist on alcohols, aniline and other organic electrolytes.

From the metallurgical point of view chief interest lies in the data on the potentials of various metals and alloys in various solutions, the discussion of the behavior of different types of alloy pairs from the equilibrium diagram point of view and the many points bearing on corrosion problems, such as the discussion of concentration cells, of oxidation and reduction phenomena, and all the factors affecting electrolytic attack and the precipitation of one metal by another out of solution.

The book is replete with references to the literature; the index covers 68 pages; the paper and printing are good, and the binding is solid enough to withstand the handling such a reference book will receive.—H. W. Gillett (0)-B-

Proceedings of the American Society for Testing Materials. Vol. 30, 1930, Part 1, Committee Reports and Tentative Standards, 1336 pages; Part 2, Technical Papers, 1085 pages. Each part $6.00 paper, $6.50 cloth, $8.00 half-leather.

All the reports and articles of metallurgical interest have been abstracted in *Metals & Alloys*. Besides the data on specifications and methods of testing, and the individual articles dealing with ferrous and non-ferrous alloys, several compilations containing vast amounts of data on special subjects make the volumes of distinct reference value. Among these may be cited in Part 1, the Report of the Research Committee on Fatigue of Metals, which summarizes present knowledge in that field, a new, extended and revised "Campbell's List of Alloys," and an extended tabulation of the compositions and properties of corrosion-resistant and heat-resistant alloys. In Part 2, a Symposium on Aircraft Materials, several articles on corrosion, and on fatigue, a summary on zinc-base die casting alloys and one on silver solders, are of especial value from the reference point of view.—H. W. Gillett (0)-B-

Advancement in Iron and Steel Metallurgy during 1929. H. M. Boylston (Case School of Applied Science). *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 23–36.

Review of progress made in ferrous metallurgy. Deals with development of stainless Fe and steel; dimensions and capacities of blast-furnaces; open-hearth furnace and practice; high-frequency induction furnaces; steel ingots; alloy steels; nature of martensite; constitutional diagrams; use of X-rays; heat treatment; and nitriding. MS(0)

Properties of Steel. *Iron & Coal Trades Review*, Vol. 121, July 4, 1930, page 13.

Abstract of a paper entitled, "Some Comments on Steel Specifications," read on May 9 by Dr. Johnston before the American Iron & Steel Institute at New York. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. RHP(0)

Steel's Growing Service to Civilization. E. F. Kenney. (Bethlehem Steel Co.) *Heat Treating & Forging*, Vol. 16, March 1930, pages 348–351.

Paper read before the American Iron and Steel Institute. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 336. MS(0)

Evaluation of Raw Materials for the Iron and Steel Industry. *Iron & Coal Trades Review*, Vol. 121, July 4, 1930, page 14.

Abstract of an article by Alfons Wagner published in *Stahl und Eisen*. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 688. RHP(0)

Recent Developments in Nickel Iron and Steel. *Iron & Coal Trades Review*, Vol. 121, Aug. 15, 1930, page 227.

Abstract of article of same title by Charles McKnight read before the American Iron and Steel Institute in New York. See *Metals & Alloys*, Vol. 1, Aug. 1930 page 687. RHP(0)

Basic Principles of Theoretical and Applied Electrochemistry (Grundzüge der theoretischen und angewandten Elektrochemie). Georg Grube. Theodore Steinkopff, Dresden, 1930. Paper, 6¼ × 9 inches, 495 pages. Price 30 RM.

This second edition is a compilation of the former 2 volume edition into one volume. It is designed upon the basis of lectures at the Stuttgart Hochschule as an elementary treatise covering the theoretical foundation of electrochemistry of solutions, molten salts and gas reactions. A few classical examples serve to illustrate the presentation of Faraday's Laws as applicable to all electrolytic chemical phenomena. The modern theories of atomic structure and their relations to the ion, proton and electron are adequately developed and followed by an extended analysis of the theory of conductance which is generously assisted by the presentation of considerable data. The dissociation theory of strong and weak electrolytes from Arrhenius to DeBye is completely presented. The galvanic cell theory and experimental practice is well presented and followed by considerable data on activity coefficients. Complete discussion of the Lalande cell, the lead storage battery and the Edison cell is given. Although the author has prepared an elementary text, he is to be commended for the generosity shown in the variety of examples presented and the completeness of description of the technique of electrolysis. The application of electrolysis technique to oxidation and reduction is adequately presented. Metallurgists will be interested in the discussion of electrolysis of molten salts which leads to the derivation of alkali and alkaline earth metals, magnesium and aluminum. The commercial processes are described with unusual simplicity and directness. The discussion of electrothermic processes in the chemical and metallurgical industries is commendably introduced by an explanation of the Y and D circuits of 3 phase systems, direct and indirect resistance heating, indirect arc light heating, and combination arc light and resistance heating. Forty-three pages are devoted to the carbide industry and its various technical processes. The electrolytic preparation of phosphorus, zinc, pig iron and steel follow. The author gives many diagrams illustrative of the processes discussed which are well chosen for the simplicity with which they depict the fundamentals of the practice.—E. Seaton Carney (0)-B-

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Letting the Specialist Prescribe Corrosion Remedies. *Chemical & Metallurgical Engineering*, Vol. 37, Aug. 1930, pages 488–489.

Outlines the research activities of the Duriron Company and gives examples of the service rendered by it in helping to solve the problems of different users of corrosion-resistant materials. MS(4)

Corrosion and Corrosion Protection on Rolled Aluminum Alloys in Aviation. (Korrosion und Korrosionschutz von Aluminium-Walzlegierungen im Flugzeugbau.) P. Brenner (Deutsche Versuchsanstalt für Luftfahrt). *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 348–356. Discussion.

Summarizes the main results of corrosion testing and outlines the influence of heat-treatment and cold work upon corrosion resistance of Duralumin and other Al alloys which can be age-hardened. The phenomenon of intercrystalline corrosion is dealt with at length. Stress is laid upon the new Duralumin ZB (L. Z. 127, Do X) which yields higher tensile strength, elongation and other physical properties without materially affecting the corrosion stability. This Duralumin is compared with the corresponding American alloy C 17 ST which, however, is higher in Si, artificially age-hardened and subject to intercrystalline corrosion. The second part of the lecture, delivered at the Corrosion Meeting of the Deutsche Gesellschaft für Metallkunde, is devoted to recent development of surface protection. The methods of Bengough, Gower, O'Brien, Jirotka, etc., on one hand and the Alclad, Allautal and Duralplat plating on the other hand are reviewed and a combination of the various protection methods suggested in conclusion. EF(4)

Application of Coatings on Steel Pipe to Prevent Corrosion. Russell W. Brandt (Youngstown Sheet and Tube Co.). *Metal Cleaning & Finishing*, Vol. 2, March 1930, pages 243–244, 247–248.

Transparent coating made up of china wood oil, linseed oil, or a mixture of the two together with a drier, are used to protect pipe in transportation or while in storage. Oils should be quick drying, and the films should be flexible and water resistant. The surface characteristics of the pipe control the non-volatile content of the oil. Pipe which has a fairly uniform film of scale does not require as heavy an oil coat as pipe which is entirely free from scale and has a very smooth bright steel surface. MS(4)

A Simple Method for Quantitative Observation of Atmospheric Corrosion in Protected Metallic Tubes. (Ein einfaches Verfahren zur quantitativen Verfolgung der atmosphärischen Korrosion geschützter Metallröhre.) W. Beck. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, pages 201–204.

Tubes of various ferrous materials, one half of which was protected by the "Schadebinde," were exposed to corrosion attack in moist air. The investigator kept track of the rusting process by means of the gas-volumetric method which mainly consists of the determination of oxygen in the surrounding atmosphere. In accordance with long time experiments in practice the accelerated tests yielded a remarkable protection against rusting and a preserved plasticity of the material tested. EF(4)

Experience with Aluminum Alloys in Sea Water. (Erfahrungen mit Aluminium-Legierungen im Seewasser.) H. Bauermeister. *Zeitschrift für Metallkunde*, Vol. 22, April 1930, pages 119–132. 8 references.

The paper presented before the Deutsche Gesellschaft für Metallkunde, Nov. 1929, summarizes the author's experience with Al alloys in continuous and intermittent contact with sea water. The observations are made on the following materials, the analyses of which are given: cast alloys of standard German and American composition, "Nitorit" pure Al casting, Silumin, KS-Seewasserlegierung, rolled alloys of pure Al KS-Seewasser plate, Silumin, Duralumin, Lautal, Aeron, Skleron and Constructal. The writer furthermore gives his experience with protective coatings of paint and metallic plating. Among casting alloys, the German and American alloy displayed satisfactory resistance to corrosion except when brass or bronze were in contact with the alloy tested or in its neighborhood. KS-Seewasser turned out very well and was superior even to pure Al. Various paints are recommended which, however, only inhibit corrosion and do not prevent it. According to the author, mechanical plating as "Duralplat" and "Allautal" is more promising. Includes discussion. EF(4)

Causes of Hydrodynamic Corrosion (Hydrodynamische Korrosionsursachen.) R. Auerbach. *AEG Mitteilungen, das Kraftwerk*, No. 1, Jan. 1931, pages 15–16.

If the flow of liquids in pipes is laminary at some places and turbulent (forming eddies) at others, electric potential differences are set up between these places. These potential differences can cause local corrosions. The author points out how the occurrence of such differences can take place in water-tube boilers and describes briefly a measuring arrangement in which a very sensitive galvanometer with 60,000 ohms/volt was used. Ha(4)

Fabrication of Acid-Resisting Steel. W. H. Hatfield. (Brown-Firth Research Laboratories.) *Heat Treating & Forging*, Vol. 16, May 1930, pages 621–624; June 1930, pages 755–758.

Lecture before the Institute of Chemical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 564. MS(4)

Heat and Corrosion Resisting Materials. H. D. Phillips (Empire Steel Castings Co.). *Heat Treating & Forging*, Vol. 16, April 1930, pages 466–470; *Blast Furnace & Steel Plant*, Vol. 48, July 1930, pages 1143–1147.

Review of the properties and principal applications from the point of view of heat and corrosion resistance of Al, Cu, Pb, Ni, Pt group, Ag, Sn, Zn, Nitralloy, cast-iron, and Cr, Cr-Ni, and high Si steels. MS(4)

Cadmium vs. Zinc Plating and the Status of Salt-Spray Corrosion Testing. H. W. Gillett. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 667–671.

A correlated abstract. The discussion indicates evidence in favor of the higher merit of thin Zn plating over Cd for corrosion resistance. The salt spray test is considered as not suitable for general corrosion resistance testing. Correspondence from 16 authorities on the subject is published. ESC(4)

The Corrosion Resistance of Nickel. (Ueber die Korrosionsbeständigkeit des Nickels.) Rudolph Krulla. *Chemiker-Zeitung*, Vol. 54, June 4, 1930, pages 429–431.

The loss of weight of pure Ni through the attack of several acids and alkalies is illustrated with curves. Temperature and presence of air increase the rate of attack. Impurities in the solutions which form galvanic couples also increase the rate of attack. If the solution forms insoluble compounds with the metal these act as a protection. The addition of Cr and Mo raise the chemical resistance of Ni. K-25 containing 25% Cr and M-20 containing 20% Mo are commercial alloys. The latter is especially resistant to HCl. The use of Ni for cooking utensils is discussed. A loss in weight of 10 g./m.^{2}/day is not considered too high. Small % of Ni dissolved in foods are not harmful. CEM(4)

Calorizing Steel to Prevent Oxidation. *Machinery*, London, Vol. 36, June 5, 1930, pages 300–302.

In describing the methods of calorizing used by the Calorizing Company, Pittsburgh, Pa., consideration is given the application of calorizing to steel tubes; the construction of calorizing furnaces for revolving retorts; the time required for calorizing operation; and the dip calorizing process. (4)

Corrosion Testing of Electrodeposited Coatings. N. J. Gebert. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 33–36.

From paper read before the Philadelphia branch of the American Electroplaters' Society. Salt-spray method has been used for determining pinholes in Ni, Cu, and Cr deposits. This method has many disadvantages for routine production testing. 2 major objections are the uncertainty of the end-point, and the length of time required. A modification of the Blum and Thomas ferroxyl reagent has been found to give reliable and accurate information in 2 minutes. The solution consists of 15 g. agar, 6 g. $K_3Fe(CN)_6$, 60 g. NaCl, 1000 cc. distilled H_2O, and 250 cc. C_2H_5OH. The solution at 120° F. is sprayed on the bars by means of O. A blue spot shows a pinhole to the steel and a brown spot shows one to the Cu. If a bar shows more than the stipulated number of blue spots after 2 minutes, it is rejected. The bars must be thoroughly cleaned before applying the solution. A considerably stronger solution sprayed on paper is used for permanent test records. MS(4)

The Velocity of Dissolution of Non-Ferrous Metals as Dependent on Cold-Rolling. (Die Lösungsgeschwindigkeit von Nichteisenmetallen in Abhängigkeit vom Kaltwalzen.) B. Garre. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, pages 200–201.

In contrast with Heyn's statements the writer established that the dissolution speed of purest Sn (99.99%) decreases with increasing rates of deformation by rolling. Small impurities in Sn, however, result in a more pronounced dissolving of cold-rolled metal than encountered in the annealed material. The dissolving rate of lead and copper decreases with increasing rolling reductions. EF(4)

Corrosion Resistant Metals. H. A. De Fries. *Engineers & Engineering*, Vol. 47, Apr. 1930, pages 81–84.

Description of KA2, KA2-S, KA4 and NCT3. Considers the composition, heat-treatment and physical properties of principal Cr-Ni steels. The effects of components on welding, riveting and heating corrosion resistance are discussed. (4)

Corrosion Resistant Steels Solve Many Problems of Designers. H. A. De Fries. *Machine Design*, Vol. 2, May 1930, pages 23–25.

Notes on the uses of non-corrosive Cr and Cr-Ni alloys. Tables give analysis of KM-1 and KA-2 alloys. Data on heat treatment are given. (4)

Pitting in Water Turbines. Elov Englesson. *Engineer*, Vol. 150, Oct. 17, 1930, pages 418–421.

Gives brief description of phenomenon of cavitation. In 1912 view was expressed that pitting was caused by mechanical action rather than by corrosion. In making microscopic investigations of pitted turbine parts difficulties were encountered. Deformation of surface crystals occurs during grinding and polishing of sample piece. Impossible to determine if deformation is due to grinding or effect of water hammer. Erosion alone will produce pitting but corrosion plays a great part although its action is secondary. To avoid pitting attention should be given to design and arrangement of turbine since cavitation is origin of pitting. Tests were made to determine properties of material resistant to pitting by cavitation. Four blades were tested made of turbadium bronze, cast steel, stainless iron, and chromium plated cast steel. Turbadium bronze blade was badly attacked showing that propeller bronzes are not sufficiently resistant for water turbines. Cast steel blade was badly pitted also. After short time, plating wore off Cr-plated cast steel. The stainless iron blade showed high resistance to erosion. It is expensive and very difficult to machine so it is not very suitable for turbine material. LFM(4)

Action of Oxygen on the Corrosion of Iron and Steel in Aqueous Solutions. H. Endo & S. Kanazawa *Kinzoku no Kenkyu*, Nov. 1930, pages 605–614.

If a piece of Fe be dipped in water, a minute quantity of it passes into solution as ferrous ion; and the dissolution is accelerated by the formation of the concentration cell of the dissolved O. The authors named this the primary factor in the first stage of the corrosion of Fe. When the ferrous ion is formed and an equivalent H ion loses its electric charge, it is deposited on the surface of the metal, which has become cathodic, as a thin film of free H gas; and if O be introduced into the above system, the oxidation of ferrous hydroxide to hydrated ferric oxide, which is precipitated as rust, and the removal of the H film from the metal surface by oxidation may take place and, consequently, the corrosion of Fe is promoted by the action of O. The authors called this a secondary factor in the first stage of the corrosion. A $^1/_{10}$ g. mol. solution of KCl was filled in 2 glass bottles with an Fe test piece in each, and O was introduced in one bottle, then the larger the amount of O introduced, the quicker the Fe plate became cathodic. If O was introduced in 2 bottles alternately, one electrode changed its potential alternately, i. e., first from cathodic to anodic and next from anodic to cathodic. This is caused by the concentration difference of O in the bottles. If a test specimen was dipped in a still $^1/_{10}$ g. mol. solution of KCl, another in an agitated one, then the latter dissolved 5 to 6 times as much as the former. This was caused by the combined action of dissolved O and the continuous contact of fresh solution with the surface of the specimen. When H gas was blown in one of the bottles, the specimen was corroded only by $^1/_3$ that in the case of O. This is also caused by the action of dissolved oxygen as the secondary factor. When one side of the thin plate of Armco Fe was covered with paraffin and a half of another side by rust and dipped in $^1/_{10}$ g. mol. solution of NaCl, then the underlying portion near the uncoated part commences to suffer from anodic attack, giving iron chloride which tends to diffuse on the cathodic area of the uncoated part and iron hydroxide produced. After 2 weeks, ferric hydroxide was formed on the $^2/_3$ area of the uncoated surface and the $^1/_3$ part remained cathodic covered with a white membrane of ferrous hydroxide although some of it must be dissolved and oxidized in the solution, this region was proved to be alkaline by phenolphthalene. This part becomes cathodic and the part covered with rust anodic and thus the corrosion continues. KT(4)

Limitations of Cadmium and Zinc Coatings. Karl A. Eckhardt (Lamson & Sessions Co.). *American Machinist*, Vol. 73, Sept. 11, 1930, pages 429–432.

Salt spray tests do not check with natural weathering tests. Sherardizing fails in salt spray tests but will in some cases stand weathering. Cadmium and zinc are both good but often not for the same work. Describes and gives results of coatings given salt spray, and atmospheric test. Concludes that the salt spray test is unreliable. Sherardizing is superior for stove parts. Cadmium is useless in this field. RHP(4)

The Electrochemical Behavior of Metals. Joseph F. Chittum. *Journal of Physical Chemistry*, Vol. 34, Oct. 1930, pages 2267–2285.

The author presents a definition of passivity—a tendency on the part of iron to exhibit a potential lower than that of an iron amalgam under the same conditions, if the amalgam should behave similar to a sodium amalgam; iron is strongly passive when it fails to replace Cu^{++} from solution—and, after discussing current theories of corrosion and passivity, deals with experiments designed to validate the above definition. Explanations of passive iron and of the mechanism of corrosion in air, in the absence of oxygen and at a surface follow, these being based on an interpretation of the variation of the potential of metallic iron with the pH value of the solution in which the iron is dipped. OWE(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Plastic Deformation (Plastische Verformung). GEORG SACHS. **Testing and Examination of Metals and Alloys (Prüfung und Untersuchung der Metalle und Legierungen).** P. GOERENS & R. MAILÄNDER. **Handbuch der Experimentalphysik.** (Ed. by W. WIEN & F. HARMS.) Vol. V. Akademische Verlagsgesellschaft, m. b. H., Leipzig, 1930. Cloth, 6 3/4 × 9 1/2 inches, 656 pages. Price 66 RM.

This fifth volume of the proposed collection of 25 is actually 2 books in a single binding. The first, accounting for 134 pages, deals in part one with crystals and their properties and in part two with the working of crystalline aggregates. In the former, methods for the preparation of single crystals of metals are described, these being followed by a discussion of the determination of orientation, the mechanism of the movement of crystalline units under stress, hardening due to cold working, recrystallization, internal stresses, effects of deformation upon elastic properties, dependence of these effects upon the temperature of deformation, and finally the fundamental information obtained from mechanical tests of single crystals. Then, with the aid of a few carefully chosen macrographs, micrographs, Laue X-ray patterns and diagrammatic records the author deals briefly but effectively with polycrystalline bodies. There are covered in turn the influence of working and recrystallization upon orientation, grain size and flow lines, internal effects due to external stress application and their identification by the resultant changes in elastic properties and X-ray behavior, hardening and softening phenomena and their theoretical explanation and finally a simple mathematical analysis of deformation due to contraction in tension testing, indentation in hardness testing and compression and elongation in rolling and drawing. The entire treatment is concise but most complete, one finding references to practically every important investigation bearing upon the author's subject.

The second "book" is divided into 3 parts. In the first, Dr. Mailänder describes the equipment and methods for the determination of the mechanical properties of metallic bodies. Although carefully describing the loading mechanisms and the measuring devices, more attention is devoted to the principles underlying them, the influence of the variables of the testing procedure and the data resulting from the examination of typical materials. Were it not for a noticeable lack of references to other than German publications in all except the description of endurance testing and the omission of several important devices developed in other countries and widely used, this section might be considered most complete for its length (350 pages) including, as it does, practically every form of mechanical testing even to determination of wear resistance, internal stresses, etc. An interesting section is devoted to stress distribution and determination in bodies of other than simple form. Occasionally, however, such as in bend-testing and wear-testing, the treatment is conservative and the most recent developments are absent (except in endurance testing references as late as 1928 are scanty).

In the second part, also by Dr. Mailänder, the study of physical properties is considered, specific weight, electrical conductivity, the magnetic characteristics, thermal expansion, thermal conductivity, specific heat and the detection of defects by radiography. Again, there is the almost exclusive reference to German publications and apparatus but here, likewise, frequent use of typical data gives the discussions a sense of completeness.

The third part by Prof. Goerens is devoted to thermal properties and metallographic characteristics. There are included examples of the thermal, dilatometric, magnetic, electrical, thermo-electric and metallographic methods for the determination of equilibrium diagrams; also, the macro- and micro-structural features appearing in metals due to their thermal and mechanical history as well as the methods used to reveal them. In the entire volume only this part suffers unduly from brevity (70 pages) and leaves the reader without much necessary information and a strong desire for more details.

The appearance of the volume is highly commendable; it is replete with excellent diagrammatic illustrations and remarkably free from uninformative photographs.—Jerome Strauss (5a)-B-

Problems of the Metallic State. (Probleme des Metallischen Zustandes.) J. D. BERNAL. *Metallwirtschaft*, Vol. 9, Nov. 28, 1930, pages 983–987.

A theoretical discussion containing 14 references. An attempt is made to find a relationship between the structural crystallography of metals and intermetallic compounds and their theoretical physical basis, with special regard to the recent studies of Slater. The nature of the different forces of attraction between atoms, metals and intermetallic compounds is pictured qualitatively, and thus a foundation is laid for their classification and an explanation of their physical and chemical properties is given. The 2 principal forces assumed are: (1) the Coulomb force of attraction between electron orbits of adjacent atoms which overlap each other; and (2) those according to Heitler and London, which are equivalent to a generalized chemical co-valence. The metals and their compounds are roughly classified according to the relative prevalence of these forces. The crystalline structure of intermetallic compounds is discussed and coördinated with their physical, magnetic and electrical properties. The chemical composition of these compounds and their laws, such as the Hume-Rotherys law, are explained. The present unsatisfactory status of our knowledge regarding solid solutions is discussed. CEM(5a)

Phase Changes in Iron-Silicon Alloys. BRADLEY STOUGHTON & E. G. GREINER. *Fuels & Furnaces*, Vol. 8, July 1930, pages 927–930.

From paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 564. MS(5a)

Plastic Areas in Structural Sections. ROBERT L. GERUSO. *Heat Treating & Forging*, Vol. 16, May 1930, pages 618–620.

Used a modified Fry macro-etching reagent to reveal strained areas caused by shearing, punching, sawing, and welding. Modification consists in the use of 3 1/3 grams less $CuCl_2$/100 cc. H_2O. Etching was improved by agitating the solution and maintaining it at a temperature of about 350° C. Presents illustrations showing areas plastically deformed by the various operations. MS(5a)

New Etching Reagent for the Macrography of Aluminum and Its Alloys. C. M. TUCKER. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 655–656.

45% HCl Sp. Gr. 1.18, 15% HNO_3 Sp. Gr. 1.42 ,15% HF Sp. Gr. 1.15, and warm water yield a reagent suitable for etching Al and its alloys. Surface should be cleaned with carbon tetrachloride and swabbed while treated to prevent film which reduces cleanliness and contrast of the etch. ESC(5a)

A Study of the Relation between Macro- and Microstructure in Some Non-Ferrous Alloys. M. L. V. GAYLER. *Engineering*, Vol. 130, Sept. 19, 1930, pages 380–382. Discussion, page 358.

Condensed from paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. LFM(5a)

A Note on the Constitution of Cadmium-Zinc Alloys. D. STOCKDALE. *Engineering*, Vol. 130, Sept. 26, 1930, page 389.

Abstract of paper read before the Institute of Metals, Southampton, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. LFM(5a)

Determination of Sulphur in Steel. (Zur Frage über den Nachweis von Schwefel in Stahl.) P. SACHAROFF & PH. RYBINSKY. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1587–1589.

After reviewing the literature on the detection of S in steels, the authors give their own results in examining the S segregations in rails. The Baumann method was found most suitable for this purpose. P has no remarkable influence on the Baumann test. It is shown that by standardizing the specifications of the Baumann test it will be possible to make the Baumann test a quantitative indicator of the amount of S present as illustrated in S prints attached. GN(5a)

Metallography of Screw Stock. (Metallographisches über Automatenstähle.) H. RUDOLPH. *Mitteilungen aus den Forschungsanstalten des G.-H.-H.-Konzerns*, Vol. 1, Nov. 1930, pages 25–32.

Discussion of S and P in screw stock. Ordinary steels with only a quarter of the S and P found in screw stock may show segregation so great that the ocal concentration of these elements is as great as in the screw stock. Inclusions in ordinary steel may be as harmful as the MnS inclusions in screw stock. In view of the better machinability, screw stock has a wider range of usefulness than is ordinarily considered. HWG(5a)

A Furnace for Metallographic Examination of Specimens at High Temperatures. B. A. ROGERS. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 9–12.

A furnace is described for heating specimens under microscopical observation. Experiments show that it is possible to observe marked surface changes upon some elements as these pass through certain allotropic transformations presumably connected with a shift of space lattice. These transformations can be traced at least when considerable percentages of other metals have been added. Observations at a magnitude of 50 to 75 diameters can be conducted on samples heated to above 1500° C. and at higher magnifications when the temperature does not exceed 1000° C. Photographs of which several have been included with this paper, can be taken at magnifications of about 150 diameters for temperatures up to 1000° C. and presumably at lower magnifications for higher temperatures. Observations have been made under these conditions upon Fe, Co, and Mn. ESC(5a)

Changes in the Composition of Cementite during the Drawing of Special Steels. (Changement decomposition du constituent cémentite au cours du revenu des aciers speciaux.) A. PORTEVIN & P. CHEVENARD. *Comptes Rendus*, Vol. 191, Sept. 1, 1930, pages 408–411.

Authors describe the results of experiments with a hyper-eutectoid Mn steel (1.5% C, 2% Mn) designed to show how the alloying element (in this case Mn) in such a steel distributes itself between the phases ferrite and cementite during treatment. They find that below 200° C., drawing causes the precipitation of a carbide having a Curie point at 120° C., the Fe remaining in the γ-state. The γ-α transformation occurs between 200° and 225° C., this change being practically complete at 260° C. The carbide precipitated during the γ-α transformation is, however, distinct from that liberated below 200° C. Its Curie point is 50° C. higher; it is, therefore, poorer in Mn. After drawing at temperatures in excess of 260° C., a portion of the C passes into solid solution—as the Fe is in the α-state the reaction *austenite* ⟶ *aggregate of martensite + cementite* must be assumed. Increasing drawing temperatures result in a decrease in the C content of the martensite. After drawing at 400° C. the steel is in the sorbitic state—*aggregate of carbide + ferrite almost free from C.* At temperatures above 400° C., the carbide precipitated during drawing reacts with the ferrite and enriches itself with Mn at its expense. This lowers the Curie point of the carbide again. OWE(5a)

The Influence of Reduction, Rolling Temperature, Cooling Conditions and the Mechanical Properties on the Structure of Low Carbon Steel. (Ueber den Einfluss des Walzgrades, der Walz-temperatur und der Abkühlungsbedingungen auf die mechanischen Eigenschaften und das Gefüge von kohlenstoffarmen Flussstahl.) A. POMP & E. FANGMEIER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 15, Report 159, pages 245–262; *Stahl und Eisen*, Vol. 50, Dec. 4, 1930, pages 1721–1723.

Low carbon flats (0.08% C) of 32 to 34 mm. width and various thicknesses were rolled in one reduction each to the same size of 20 mm. thickness and cooled either rather rapidly on a 10 mm. thick cast iron plate or relatively slowly in kieselguhr. The following table contains the treatment of the 2 groups tested:

Treatment of Steel Tested

Height before rolling mm.	Height after rolling mm.	Reduction mm.	Reduction %	Rolling temperature ° C.	Cooling conditions
			Group I		
30	20	10	33	700	Cooling on plate and Kieselguhr
28	20	8	29	800	
26	20	6	23	900	
24	20	4	17	1000	
22	20	2	9	1100	
				1200	
			Group II		
20	10	10	50	700	
18	10	8	44	800	
16	10	6	37	900	
14	10	4	29	1000	
12	10	2	17	1100	
				1200	

The tensile strength, yield point, elongation, hardness, notch toughness and the grain size were determined. The most favorable physical properties are obtained in both groups at rolling temperatures between 900° and 1000° C. At this rolling temperature, the values of normalized steel are at least reached if not surpassed. Indications of strain hardening appear in rolling at 700° C. Tensile strength, yield point, and hardness increase; elongation, reduction of area, notch toughness and grain size decrease. In rolling between 700° and 900° C., the tensile strength, yield point, hardness and, particularly, the notch toughness decrease due to the coarse grain recrystallization. This holds especially for the slowly cooled samples. At rolling temperatures above, the effects of superheating with its impairing influence on the properties are observable. GN(5a)

The Nature of Hardness. (Ueber die Natur der Festigkeit.) M. POLANYI. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 113–119.

Philosophical discussion of why a metal is hard. Illustrated by diagrams showing irregular atom distribution in gases, amorphous bodies and oriented arrangement in crystals, lattice structure in single crystals and polycrystalline materials, slip in single and poly-crystals, and distortion of the lattice on bending. Crystalline materials may allow themselves to be plastically deformed so that the most closely packed atom rows glide into positions so that these rows are parallel. At very low temperatures, amorphous bodies are completely brittle, while crystalline ones are not much less ductile than at ordinary temperatures. To produce plasticity, the still generally valid orderly arrangement of the atoms in the crystal must be somewhat disturbed. A distorted crystal has a mixed crystalline and amorphous character. (5a)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

The Magnetic Properties of Permalloy with Internal Stresses and Their Influencing by Exterior Tension and Compression. (Ueber die magnetischen Eigenschaften von Permalloy mit inneren Spannungen und ihre Beeinflussung durch äusseren Zug und Druck.) OTTO VON AUWERS. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 9, No. 2, 1930, pages 263–293.

The extraordinary sensitiveness of Permalloy to mechanical forces has long been recognized; longitudinal tensile stresses increase the permeability enormously while bending stresses destroy those excellent magnetic properties if they disturb the lattice structure. On account of the great importance of this material in telephony and telegraphy the interdependence between magnetic properties and mechanical forces has been further investigated in the present work with regard to (1) influence of internal stresses in the material; (2) influence of longitudinal tensile stresses; (3) influence of hydraulic pressure. These influences were studied on covered wires, that is wires of permalloy which have a core of another alloy. By suitable thermal treatment inner stresses could be produced at will. The influences of tension and compression were examined for the original curve, μ-curve, maximum permeability, remanence, coercive force, and position of hysteresis loop. For the latter it is shown that the loops are tilted under the action of tensile stress about a fixed axis passing through the zero point so that there exist 2 fixed points on the increasing and decreasing branches, the coördinates of which are independent of the load. Compression acts essentially only on the coercive force but in an opposite sense as tension. Eighty six figures and 20 bibliographical references supplement this very exhaustive investigation. Ha(6)

Fatigue Stresses with Special Reference to the Breakage of Rolls. F. BACON (Univ. College, Swansea). Advance copy for Nov. 18, 1930 meeting South Wales Institute of Engineers, 112 pages.

Starting from the observation that the fractures of chilled Fe rolls are characteristic fatigue failures, Bacon examines the relation of fatigue properties to roll service. Available data indicate that the endurance limit for the gray Fe core of a good roll should be about 11,000 lbs./in.^{2} just below the mottle. No good estimates are available on the endurance limit of the mottle itself, nor on that of the chill. As a purely tentative figure it is thought that the chill might show an endurance limit of 18,000 lbs./in.^{2} From such data as are available, it would appear that the endurance limit of gray Fe at the working temperature of the rolls will not be less than at room temperature, but nothing is known of the properties of chilled and mottled Fe at elevated temperatures. Broken rolls show heat-tinted cracks. Mathematical studies indicate that the fatigue stresses in uncracked rolls may not usually exceed the endurance limit. But if surface hair cracks form, the repeated stresses may very readily propagate the cracks, especially if the cracks penetrate below a given depth. This critical depth, found by mathematical study, coincides with the depth of chill preferred in service, i. e., about 0.035 times the diameter of the roll. The idea is advanced that surface cracks readily propagate between the columnar crystals of the chilled layer and tend to stop at the mottle, unless the stress at that point is high enough to make them continue to propagate. Failure by crack-continuation is then an important concept and the resistance of the Fe in the roll, not only to the formation, but also to the propagation of a crack, needs attention. If a new roll is severely overloaded it will break in a few revolutions at a surface stress well below its static modulus of rupture. It is suggested that a study of some method of evaluating the "running modulus of rupture" as well as the determination of the endurance limit of chilled and mottled Fe would be of value in the effort to choose a metal that will best resist roll failure. The combined torque and rotary bending stresses in the bottom roll are examined mathematically. Similar study of top rolls leads to the conclusion that on the basis of the theory of failure by fatigue, the top and bottom rolls should be equally likely to break. This is borne out in practice. Work done by Dr. F. Rogers in 1905 is referred to, in which the formation of incipient cracks in a fatigue specimen was studied by heating under oxidizing conditions so that cracks already formed became heat-tinted. The specimen was then re-run to failure. The life in the second stage (all tests, on a 0.27% C, 1% Mn steel being made at the same stress, 50,000 lbs./in.^{2}) was proportional to the extent of the heat-tinted cracks. Analogous temper colors are found on rolls fractured in service. Mathematic analysis is made of the stresses in rotating beams of lenticular section, with part of the cross section broken through by the advance of a progressing fatigue failure. The hair crack marks on the fatigue fractures of shafts, rolls, etc., are generally, in unflawed material, simple geometrical curves. From his analysis, Bacon concludes that the roots of fatigue cracks in rotating beams tend to lie on surfaces of uniform crest stress ratio. HWG(6)

Fatigue Strength of Nitrided Steels. (Biegeschwingungsfestigkeit von nitrierten Stählen.) O. HENGSTENBERG & R. MAILÄNDER. *Krupp'sche Monatshefte*, Vol. 11, Sept.-Oct. 1930, pages 252–254.

Endurance bending tests were performed on 6 different steels after they had been subjected to 3 different treatments: (a) quenched and drawn, (b) quenched and drawn and finally tempered at 500° C. for 48 hrs., (c) quenched and drawn and nitrided at 500° C. for 48 hrs. The table below gives the composition and treatment:

Symbol of	Chemical Composition							Heat Treatment	
Steel	C	Si	Mn	Cr	Al	Ni	Mo	Quench	Draw
FP 15	0.3	.43	.41	1.43	1.12	..	..	920° C. oil,	650° C. air
FP 13	0.52	.14	.27	1.74	1.28	..	..	900° C. oil,	650° C. air
FP13A	0.52	.14	.27	1.74	1.28	..	..	880° C. oil,	670° C. air
FPK 13	0.32	.22	.72	1.24	.93	..	0.34	840° C. water,	600° C. air
FPE 23	0.42	.19	.38	1.68	1.33	2.65		870° C. oil,	660° C. air
FK 345	0.15	.25	.4	.85	..	..	0.41	930° C. oil,	650° C. air

The nitrided samples show an essential increase of the endurance bending strength as determined with machine developed by C. Schenck, Darmstadt, Germany. The results are as given in the following table:

Symbol of Steel	Heat Treatment	Endurance Bending Strength
FP 15	a	42 kg./mm.^{2}
	b	40–41 kg./mm.^{2}
	c	55 kg./mm.^{2}
FP 13	a	50–51 kg./mm.^{2}
	b	52 kg./mm.^{2}
	c	67 kg./mm.^{2}
FP 13 A	a	46–47 kg./mm.^{2}
	c	59 kg./mm.^{2}
FPK 13	a	48–49 kg./mm.^{2}
	c	62–63 kg./mm.^{2}
FPE 23	a	55 kg./mm.^{2}
	c	68 kg./mm.^{2}
FK 345	a	43 kg./mm.^{2}
	b	46–47 kg./mm.^{2}
	c	67–68 kg./mm.^{2}

The increase of the endurance bending strength of the nitrided sample does not only depend on the composition of the steel but also on the thickness of the nitrided skin in relation to the core. Small surface faults of the nitrided specimens have no influence on the endurance bending strength. GN(6)

Effect of Section Size on Physical Properties of Cast Iron. A. L. BOEGEHOLD. *Proceedings American Society Testing Materials*, Vol. 30, Part 1, 1930, pages 199–205.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846. (9)

The Cupping Test for Aluminum Sheet. ROBERT J. ANDERSON. *Metal Industry*, London, Vol. 37, Sept. 19, 1930, pages 265–268.

As measure of drawability, the most reliable and most practical and simple test is the cupping test, such as is made on Olsen ductility or Erichsen indentation machines. Describes the apparatus and method of testing. Actual values for Al sheets depend upon temper of sheet, its thickness, composition, grain size and general quality. Contains a number of tables giving cupping values for sheets of various gages. VSP(6)

The Nature of Remanence and the Losses by Hysteresis. (Ueber die Natur der Remanenz und der Hysteresisverluste.) N. S. AUKLOV. *Zeitschrift für Physik*, Vol. 64, Sept. 22, 1930, pages 817–829.

It is shown theoretically that single ferromagnetic crystals do not possess remanence nor losses due to hysteresis. These are only found in polycrystalline aggregates with internal strain. To obtain, therefore, a ferromagnetic alloy with low hysteresis losses the internal strain must be small and the single crystals of the alloy should not possess magnetostriction. The magnetic properties of permalloy and perminvar are discussed. (6)

How Designers Can Appraise Metals from Hardness Test Data. E. S. AULT. *Machine Design*, Vol. 2, Feb. 1930, pages 35–38.

A statement of the fundamentals of hardness testing and a classification of purposes. Rockwell, Brinell and Vickers testing machines are described. (6)

Significance and Evaluation of Fracture Elongation of Metals. (Zur Deutung und Bewertung der Bruchdehnung bei Metallen.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 61–71.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 796. (6)

Notched-Bar Impact Tests—Standard Test Piece. (Kerbschlagproben—Normenprobe.) R. PAWLISKA & M. SCHMIDT (Gebr. Böhler & Co., Austria). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 217–221.

The variables in impact testing are briefly discussed. A square Charpy bar with 45° notch with 0.25 mm. root radius is favored. HWG(6)

Comparative Investigations of Rails with Water-Hardened Surface. (Vergleichende Versuche an Schienen mit wassergehärteter Lauffläche.) O. PILZ & H. MEYER. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1557–1566.

In referring to the failure of rails, the literature on this subject is dealt with showing that among the rails with an increased resistance to wear, those with a not too-pronounced hardness of the surface are supposed to be most suitable due to the high toughness which decreases cracks. Transverse cracks are probably not a primary cause of failures. Shatter cracks have not yet been found in Thomas steel. The origin of shatter cracks is discussed. In order to determine the influence of a very hard surface, rails which have been surface hardened by various methods have been tested by the authors. The one group of rails tested was manufactured by the French company, Compagnie des Forges de Chatillon, Neuve Maisons; the other group was a product of the German Maxhütte, Rosenberg, Bavaria. The composition, structure, conditions of segregations, distribution of the hardness along the surface, the results of tensile tests and impact tests, of notch toughness tests and endurance impact tests as well as the wear resisting properties are given. The Maxhütte rails with a harder surface gave better wear resisting properties and more favorable results in practical application. GN(6)

Cast Iron Testing in Great Britain. J. G. PEARCE (British Cast Iron Research Association). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 1–4.

Discusses consideration leading to adoption of standard transverse bars cast separately: S—0.975″ diameter, 15″ long, 12″ centers, to represent castings under ¾″ thickness; M—1.2″ diameter, 21″ long, 18″ centers, to represent castings ¾″ to 2″; L—2.2″ diameter, 21″ long, 18″ centers, to represent castings over 2″. Tensile bars from these are machined to S, 0.564″; M, 0.798″; L, 1.785″ diameter at the breaking section. HWG(6)

The Testing of Cast Iron. (Die Prüfung von Gusseisen.) E. PIWOWARSKY (Technische Hochschule, Aachen). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 5–9.

List of tests used in Germany. Description of each extremely brief. Shear tests show no satisfactory relation to tensile tests. (6)

Electromagnetic Method for Testing Large Rotors for Hidden Defects of Manufacture. (Elektromagnetisches Verfahren zur Prüfung grosser Induktorkörper auf verborgene Herstellungsfehler.) R. POHL. *Forschung und Technik*, 1930, pages 455–468.

A method is described by which hidden defects in large cylindrical forged pieces with an axial bore can be detected. A current of from 1000 to 2000 amperes is sent from one side of the piece such, as a big shaft, to the other side diametrically across from it so that it flows to both sides of the bore. If a coil is placed in the latter and the current broken or reversed, the coil which is connected to a very sensitive mirror galvanometer will be subject to a magnetic field should a magnetic asymmetry be present due to defects. The method is theoretically discussed and instruments described, as well as test results on a shaft of 5280 mm. length, 495 mm. diameter and 69.5 mm. bore. The sensitivity of the method is very great and is little influenced by exterior disturbances. Some suggestions are added to make this method still more convenient for practical application. Ha(6)

A New Testing Apparatus for Deep-Drawing Sheet. (Ein neues Prüfgerat für Tiefziehbleche.) G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 80–85.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

Fatigue Tests of Fillet Welds. R. E. PETERSON & C. H. JENNINGS. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 384–394.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846. (6)

Mass Testing of Workpieces with the Rockwell Hardness Tester. (Massenkrontrolle von Werkstücken.) A. RUETER. *Maschinenbau*, Vol. 8, Dec. 5, 1929, pages 790–794.

The Rockwell hardness tester, its performance and operation, is described. On the basis of actual experience, the use of the instrument for mass testing is outlined and the influences leading to deviating indications are investigated. By means of frequency curves, tolerances for test pieces are determined. (6)

Relationship between Rockwell and Brinell Numbers. S. N. PETRENKO. *Metals & Alloys*, Oct. 1930, pages 782–787.

An extended abstract. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. ESC(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Technique of Electro-Deposition (Galvano-Technik, Galvanostegie und Galvanoplatik). H. KRAUSE. Max Jänecke Verlagsbuchhandlung, Leipzig, 1931. Paper, 6 × 8 1/4 inches, 272 pages. Price 5.40 RM.

This edition resembles previous editions, but is brought more nearly up to date, and contains a little new matter on plating masses of objects in drums, and an index, lacking in previous editions.

The theory of electroplating is briefly discussed, and directions given for plating Ni, Co, Cr, Fe, Zn, Cd, Sn, Pb, Cu, brass, Ag, Au, Pt and Pd. In most cases, mention is made of a considerable number of baths suggested by various authorities without giving sufficient critical discussion to tell the reader what their advantages and disadvantages are. When information in periodical literature is cited, the names of the authors are given, but not the journal reference. Hence, the reader will find it difficult to look up the original literature.

The paper and printing are good.—H. W. Gillett (7a)-B-

Nickel Anodes. G. W. PAWEL & G. B. HOGABOOM. *Metal Industry*, N. Y., Vol. 27, June 1929, page 288.

The importance of a more comprehensive knowledge of the factors governing the successful deposition of nickel from high purity anodes is emphasized in correspondence arising out of a recent paper on the influence of certain addition agents to nickel-plating solutions. It is pointed out that anodes which are of high quality and capable of producing an excellent quality of plate are being used in a number of cases under conditions which make it impossible to obtain satisfactory results. The anode, though of primary importance, is only one factor in the situation, and while it is admitted that still further work is needed on the production of an anode which will corrode evenly and without excessive sludging, it is urged that much also remains to be done along the lines of adjustment of composition of the solutions used, and the control of their acidity. (7a)

Nickel Plating of Small Aluminum Parts. ANDREW V. RE. *Metal Cleaning & Finishing*, Vol. 2, April 1930, pages 323–324, 344.

Gives solution formula and procedure to follow in cleaning, acid dipping, brass plating, Ni plating, and buffing. MS(7a)

Chromium Plating. E. W. DOBBS. *Metal Industry*, London, Vol. 36, Feb. 7, 1930, page 168.

Abstract of paper read before the Birmingham and Midlands local section of the Society of Chemical Industry. VSP(7a)

Mass Production Methods in Depositing Nickel at High Current Density. N. R. LABAN. *Metal Industry*, London, Vol. 36, June 13, 1930, pages 629–630; June 27, 1930, pages 674–676; Vol. 37, July 11, 1930, pages 39–40.

Includes discussion. From paper presented before the Electroplaters' and Depositors' Technical Society. Describes methods which have proved satisfactory over a period of several years for the deposition of Ni. Methods are particularly suitable when Ni is used as basis for Cr. Current densities between 60 and 100 amp./ft.^{2} are practical for the majority of components used in motor and cycle work. Advantages in use of high C. D. are not confined to output. Deposits obtained have excellent mechanical properties, well suited to engineering purposes. VSP(7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Hot Galvanizing (La galvanisation a chaud). M. C. KLUYTMANS. Bibliothique de L'Usine, Paris, 1927. Paper, 6 × 9 1/4 inches, 86 pages. Price 18.80 Fr.

Brief generalities on hand and mechanical galvanizing, covering about what might be expected in a pamphlet of this sort, if one doesn't expect any real metallurgical information. As samples of the type of information, we cite the following: The lower part of the pot is customarily spherical or flat, and its form is oval or rectangular. . . .The melting point of zinc is +12° C. (doubtless poor proof-reading for 412°, itself incorrect for pure zinc, with no explanation given that it refers to impure zinc). . . .The workmen at the pickling baths should be given strict orders to drink their quart of milk per day, to eliminate the irritation due to acid vapors. . . .

The author's conclusions are, that in spite of all the literature on galvanizing, practice will teach more than books, and that one can read and re-read the treatises, but if he has not breathed the acid fumes, etc., he will have to pass through these discomforts to get results.

In respect to any help to be gotten from this particular book, the author seems to have appraised the situation correctly.—H. W. Gillett (8)-B-

Hot Galvanizing as It Affects Mild Steel. J. C. ALLAN & R. L. GERUSO. *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 70–75.

Investigation of the effect of galvanizing on the physical properties of cold-worked bolt steels. Steel used contained 0.22% C, 0.89% Mn, 0.14% P and 0.034% S. It was annealed at 840° C. for 1 hr. and then cold worked 4, 8, 12, 16, and 20% by elongation in an Olsen tension machine on standard A.S.T.M. test specimens 4 in. long. Bending and notched-bar impact specimens were shaped from these elongated specimens. Every specimen was pickled in warm H_2SO_4 prior to galvanizing at 440° C. Results of tests show that galvanizing raises the yield-point and tensile strength of steel cold worked from 0–20%. The increased values, however, are not much different from those obtained when such steel is cold worked 0–20% and then subjected to simple annealing at 440° C. The ductility, as measured by elongation, closely approximated the values obtained when cold-worked steel is annealed 440° C. Notched-bar impact resistance of steel cold worked 0–20% is decidedly lowered by galvanizing. This galvanized steel when sorbitized, has an Izod notched-bar impact resistance of approximately 45 ft.-lbs. Galvanized sorbitic steel and steel cold worked 10–16% prior to annealing at 440° C. have approximately the same resistance. Galvanized overstrained steel is very brittle. In the bending test, cracks became very visible with steel overstrained 12%. Includes illustrations of strain lines in bolts during various stages of manufacture and photomicrographs of faulty galvanized bolts. It is concluded that cold-worked steel should be thoroughly annealed before galvanizing, particularly if the steel is deformed 12–16%. Any unnecessary surface irregularities should be avoided in preparing material for hot galvanizing. MS(8)

Metal Spraying. S. H. GRIFFITHS. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 45, 1929–30, pages 60–65.

Elementary description of the metal spray process. Particles produced by the spray should be of about the same size as the cavities formed on the surface to be coated by the preliminary sand blasting. Porosity of the deposits is remedied by treatment with a "special chemical dope" (apparently of the type of Bakelite varnish) or by a type of burnishing operation that causes the metal to flow. Zinc coatings are the ones more readily applied. Other sprayed metals will cling well to a sprayed zinc surface. Sprayed aluminum coatings for grate bars, annealing boxes, etc., are best applied on cast iron of low silicon content as that is less liable to growth and consequent cracking of the coating. (8)

INDUSTRIAL USES & APPLICATIONS (9)

Tubes for High-Pressure Water-Tube Boilers. S. F. DOREY. *Engineer*, Vol. 150, Nov. 21, 1930, pages 566–568; Nov. 28, 1930, pages 589–591. Discussion pages 572–573, 600–603.

Condensed from paper read before the Institute of Marine Engineers, Nov. 11. See also editorial comment on pages 599–600. LFM(9)

Steels in Marine Engineering and Shipbuilding. J. W. DONALDSON. *Metallurgia*, Vol. 3, Dec. 1930, pages 41–45.

Discusses use of carbon and alloy steels in shipbuilding, boilers, turbines, oil engines, and gears. Predicts an extended replacement of carbon steels and non-ferrous alloys by alloy steels. JLG(9)

Welding Processes Used in Making Planes. J. B. JOHNSON. *Welding*, Vol. 1, Sept. 1930, pages 735–738.

The following types of welding have been used extensively enough in the aircraft industry to be called production processes: (1) gas welding (oxy-acetylene and oxy-hydrogen); (2) electric arc welding (a. c. and d. c.); (3) electric resistance welding (flash welding and spot welding). Electric butt welding and the Hyde process of copper welding are used to a limited extent. Oxy-acetylene welding is used for fabricating some part of the airplane structure and in many plants for all ferrous metal joints in the fuselage, wings and landing gears. Oxy-hydrogen welding is used extensively for welding aluminum. Electric arc welding has been used for joining carbon and alloy steel parts but not for non-ferrous metals; it can be used successfully on material 0.031 in. or more thick. D. c. machines give better results than a. c. Arc welding is not suitable for close fitting parts. Flash weld is limited to pieces of the same cross section. The application of spot welding to austenitic steels has been more successful than in pearlitic structural steels. W(9)

Applications of the Welding Processes on the Boston and Maine. Part II. M. A. THOMPSON. *Welding*, Vol. 1, Jan. 1930, pages 168–170.

Cost figures for gas welding cylinders, frames and miscellaneous repair jobs, showing saving effected. W(9)

Production and Thermal Treatment of Sheets for Automotive Industry. (La fabrication et les traitements thermiques de la tole pour l'industrie automobile.) A. T. KATHNER & P. DAMIRON. *Revue de Metallurgie*, Vol. 27, Nov. 1930, pages 615–629.

A rather detailed survey of the demands made on different types of sheets in the automobile industry, their manufacture and heat treatment. The article is based on U. S. practice and deals both with physical and microscopic testing and all phases of the manufacture are briefly touched, special attention being given to heat treatment. 15 microphotographs and 14 references are given. JDG(9)

Stainless Steel Replaces Plated Parts. 1930. *Heat Treating & Forging*, Vol. 16, April 1930, page 486.

Enduro KA2 and similar alloys are being used extensively for auto body trim. Parts are polished after being formed. Polishing materials must be free from Fe. For flat surfaces it is necessary to begin operations with coarser grits than for formed articles. General rule is to use finest abrasive possible. Polishing speed should be 5000–6000 lineal ft./min. First few polishing operations may be done dry; finally, should be done on greased wheels. Buffing must be done with Fe-free compound. For mirror finish special buffing compounds must be used followed by Cr_2O_3. The alloy work hardens very rapidly, and in its fabrication, it is necessary to perform as much work as possible in a single drawing operation and to re-anneal between operations. Blanks used should be of sufficient size so as not to require excessive ironing out in the dies to secure cup depth. Use of a proper lubricant of suitable consistency and body is important. MS(9)

Applying Aluminum in the Wrought Condition. F. V. HARTMAN. *Machine Design*, Vol. 2, June 1930, pages 29–33.

A discussion of the advantageous uses of wrought Al alloys in various machine parts. Gives notes on sheets and tubing, and tables giving composition of wrought Al alloys. Alloys are aged artificially. (9)

White Gold Jewelry. C. M. HOKE. *Brass World*, Vol. 26, Dec. 1930, pages 317–319.

Ag, Ni and Pd are widely used as whiteners of gold. Pd is much more resistant to tarnish and its lower present cost should result in a wider usage. Hints on the manufacture of white Au are made, with suggestions for the man at the bench. WHB(9)

Metals for Modern Boiler Construction. J. GOULD COUTANT. *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 476–477.

Properties of steel and alloys at high temperatures must be considered in the design of boiler-room equipment operating at high temperatures and pressures. Shows, by means of examples, how to determine the factor of safety based on yield-point and on creep limit, and thus the maximum temperatures to which steel may be subjected. Factor of safety based on creep limit should be not less than 2 when all conditions are known and about 4 when not known or when there are fluctuations. Includes curves of properties of various steels at temperatures up to 1100° F. MS(9)

The Use of Non-Ferrous Metals in the Aeronautical Industry. D. HANSON. *Metal Industry*, London, Vol. 37, Sept. 12, 1930, pages 247–249, 252; Sept. 26, pages 295–296.

Condensed from the Institute of Metals autumn lecture. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 8. VSP(9)

Making the Steel Equipment Dollar Go Further. FRED D. HARTFORD (Burkhardt & Sons Steel & Iron Works). *Chemical & Metallurgical Engineering*, Vol. 37, May 1930, pages 299–302.

Discusses some factors in the economical use of rolled steel for heavy chemical equipment such as open tanks, blow-cases, tank-car tanks, and filter vessels. Parts subject to corrosive influences should be thickened. Combinations of riveting and welding usually are most economical. MS(9)

Aluminum Alloys in the Transportation Industry. A. H. WOOLEN. *Proceedings Western Railway Club*, Vol. 42, Jan. 1930, pages 20–32.

The Al conduit is finding increased use for protecting wiring on locomotives, cars, shops and engine houses and does not corrode or rust under conditions existing in these locations. See *Metals & Alloys*, Vol. 1, July 1930, page 631. (9)

The Rolling Mill Bearing. (Das Walzenlager.) A. KRETZLER. *Stahl und Eisen*, Vol. 50, May 29, 1930, pages 769–771.

The advantages resulting from a proper selection of the metal for rolling mill bearings as well as the importance of a suitable thickness of the bearing is pointed out. The production of the rolling mill can be increased due to fewer delays in the mill. GN(9)

Aluminum Alloys Used in Commercial Motor-Vehicles. F. D. GOLL. *S. A. E. Journal*, Vol. 27, Dec. 1930, pages 637–645, 654.

The paper is confined to a discussion of Al for commercial motor-truck bodies and tanks. The advantages of Al bodies as to weight saving, low maintenance cost, residual value and better appearance, are stated also, as well as the special advantages applicable to certain types of body now in operation. The paper also treats Al motor-truck tanks in some detail, and presents numerous statistical data in tabular form. (9)

HEAT TREATMENT (10)

Hardening (10a)

On Steel Hardening. (Ueber die Stahlhärtung.) H. ESSER & W. EILENDER. *Archiv für Eisenhüttenwesen*, Vol. 4, Sept. 1930, pages 113–144; *Stahl und Eisen*, Vol. 50, Nov. 13, 1930, pages 1616–1617.

After having proven in preliminary quenching tests that the heat effects occurring during the quenching of steel specimens in water cannot be determined accurately, the quenching was performed by means of gas. The heating and quenching of the samples were performed in vacuum in a container designed for this special purpose. The specimens used were either thin sheets (0.5 to 1 mm. thick, 1–2 mm. wide) or small balls 1–2 mm. in diameter. Quenching curves with varying cooling velocity were taken on C steels from 0.01 to 1.75%. The results permit certain conclusions to be drawn as to the nature of Ar′ and Ar″. The heat effect occurring between 300° and 400° C. with cooling velocities of about 100° to 200°/sec. is assumed to be a tempering effect due to the essentially decreased cooling velocity within this temperature range. In considering these results, the authors arrive at a new explanation for the causes of temper brittleness. A hardening diagram for a cooling velocity of 1000°/sec. is designed, indicating that the heat effects during quenching are similar to the transformations of the Fe-C diagram. It must probably be assumed that martensite is not a pseudo-solid solution but a heterogeneous submicroscopical mixture of α-iron and cementite. It is, furthermore, concluded that all Fe-C alloys, even those with very low C contents, are hardenable if they are sufficiently rapidly cooled. The microscopical investigations are in accordance with the results of the thermal analysis. The development of a new theory of hardness is attempted, which explains the hardness in quenching, the austenite with critical velocity by the following 2 factors: (1) the high degree of dispersion of the cementite; and (2) the pronounced distortion of the α-lattice during the γ-α transformation and the cementite precipitation in the temperature range of a decreased plasticity of the steel. Both factors account for the hardness. GN(10a)

Gas for Lead Hardening of Shovels. C. GEORGE SEGELER (American Gas Ass'n). *Iron Age*, Vol. 125, June 26, 1930, pages 1880–1882.

Advantage of lead hardening is that the high specific gravity of Pb permits the shovels to float in the bath. Describes method used by Baldwin Tool Works, Parkersburg, W. Va. Electricity is employed only when the press of business goes beyond capacity of gas-heated pots. Compares heating values of gas and electricity; character of steel used has bearing. New form of gas heating known as immersion heating is being developed. VSP(10a)

Annealing (10b)

Bright Annealing of Steels in Hydrogen. FLOYD C. KELLEY (General Electric Co.). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 388, 1931, 9 pages.

Low carbon steels even when annealed in a stream of purified H_2 are colored blue, and stainless irons are colored green. The color is due to reactions with small amounts of water vapor, which is held in the refractories or leaks into the furnace. The blue color is due to iron oxide and the green color to an oxide of chromium. Low carbon steels can be bright annealed in H_2 by wrapping in sheet iron or by packing in a tube whose ends are closed with sheet iron, but under such conditions the Cr alloys are colored green. The author found that if the Cr alloys were protected with the sheet metal or pipe and then packed in a mixture of alumina and metallic Cr (half and half) they could be bright annealed in H_2. Al, Mn, Si, Fe-Si and Fe-V can replace alumina. A laboratory furnace for the bright annealing of stainless iron and alloys of the 18–8 type, in which the H_2, after preliminary purification, is passed through a mixture of alumina and Fe-Si, is described. The mixture of alumina and Fe-Si is in a second furnace maintained almost at the annealing temperature. For the nickel-chromium iron alloys the annealing temperature was 1100° C., and the flow of H_2 from 2.5 to 5 liters per hour. JLG(10b)

Annealing Brass. BASIL BARHAM. *Metal Industry*, London, Vol. 37, July 25, 1930, page 77.

Treats briefly of a series of experiments carried out to determine the temperature range within which internal stress may be removed from cold worked 70:30 brass without serious reduction of hardness. Discusses also the constitution and mechanical properties of Zn alloys containing Cu up to 10% and Al up to 15%. VSP(10b)

Aging (10f)

The Artificial Ageing of Duralumin and Super-Duralumin. K. L. MEISSNER. *Engineering*, Vol. 130, Sept. 19, 1930, page 358.

Abstract of a paper read before the Institute of Metals, Sept. 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. LFM(10f)

Experiments on the Aging of Steel. (Versuche über das Altern von Stahl.) G. SACHS & W. STENZEL. *Metallwirtschaft*, Vol. 9, Nov. 21, 1930, pages 959–965.

Contains 10 references and 16 graphs. Very pure 0.04 C, 4 mm. diameter steel rods were annealed at 940° C. for 1/2 hr. in vacuo, slowly cooled to 200° and quenched in water. They were then twisted 1/2, 1 1/2 and 4 turns in a torsion machine and aged for varying periods at 20° to 100° C. in water, 200° in oil and 300° to 500° in saltpeter, and cooled in air. The physical properties were determined and are shown in the form of graphs. Without twisting, the tensile strength increases 1.3% after 5 months' aging at 20°. The tensile strength of twisted rods increases at 20° up to 30 days, at 100° it reaches a maximum quickly, then decreases. The speed of change immediately after twisting is much greater when aging at 100° than at 20°. With greater amount of twisting, the aging temperature for the greatest change is lower. The effect of alternate twisting and aging was also determined. Other steel rods were quenched at 700° C. in water, which raised the tensile strength from 30.5 to 38.5 kg./mm.^{2} They were then similarly aged and tested. At 20°, there is first a slight drop in tensile strength, then an increase of 52% after 22 days. At 100°, the maximum is reached after 10 min. and it then falls below the original tensile strength. The effect of twisting and quenching is similar. In both cases the maximum effect is reached after days or months aging at room temperature and after several minutes aging at higher temperatures. The maximums decrease with rising temperature. When quenching and twisting are combined, the maximum is reached later than when quenching alone. The theory of the changes is discussed. CEM(10f)

Contribution to the Problem of Dispersion Hardening Based on Experiences Gained with Iron-Alloys. (Zur Frage der Vergütung auf Grund der Erfahrungen mit Eisenlegierungen.) W. KÖSTER. *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, pages 289–296; discussion pages 302–303.

Paper before the Deutsche Gesellschaft für Metallkunde, March 1930. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 40. EF(10f)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Development of Welding Department at Carnegie Institute. SAMUEL E. DIBBLE. *Welding*, Vol. 1, Oct. 1930, pages 830–831.

The present status of the department contrasted with its inception in 1916. W(11c)

Cross Wire Resistance Welding. R. S. DONALD. *Welding*, Vol. 1, April 1930, pages 392–394.

Cross wire welding is to-day the accepted method of joining wires or rods since the welded material is stronger and lighter than by any other method of fabrication. Clean material is prerequisite. The size of wire that can be successfully welded is conditioned only by the current that can be economically supplied. It is important not to reduce the cross section of the wire more than one third of its diameter; maximum strength is thereby attained. In general, any kind of wire can be welded; satisfactory results and high production are being obtained on iron, steel, brass, bronze, aluminum and molybdenum nickel, with speeds as high as 180 welds per minute. Elkonite dies are adapted to the speeds required by modern production methods. Electroforging is a new type of cross wire welding, in which the intersection is made into one piece by electroforging under enormous pressure. W(11c)

Proposed Specifications for Fusion Welding of Drums or Shells of Power Boilers. *Journal American Welding Society*, Vol. 9, July 1930, pages 15–41.

Discussion of paper read before the annual meeting of the American Welding Society. LFM(11c)

Welding Theory Needed. *Journal American Welding Society*, Vol. 9, July 1930, page 4.

Reprinted from *Engineering News-Record*, May 15, 1930. LFM(11c)

Preheating Castings for Welding. *Fuels & Furnaces*, Vol. 8, Aug. 1930, page 1160.

Most practical and economic method of preheating large cast iron pieces, particularly where the entire piece is to be heated is the use of a temporary fire-brick furnace. MS(11c)

Electric Arc-Welding of Aluminum. FRED J. GIROUX. *Welding*, Vol. 1, Oct. 1930, pages 838–840.

An aluminum electrode has been developed for arc-welding aluminum that avoids the faults of the oxy-acetylene process. The new process avoids the use of a slag flux cleaner and in most instances the preliminary heating is unnecessary. A perfect autogenous welding of pure aluminum or alloys of other metals is obtained. The aluminum electrode is adapted for the repair of pieces stamped from pure aluminum or cast from light alloys, even though the metal contains a certain proportion of zinc. The method employed is outlined. W(11c)

Are You Going to Weld? T. H. BOOTH. *Welding*, Vol. 1, Oct. 1930, 846–848.

The use of welding on small lot jobs of a wide variety, in contrast to specialized and repetition work has received scant notice. Fundamental factors such as correct design, selection of equipment, shop equipment, the requirements of a good welder, the use of jigs and fixtures, and economic questions are considered. W(11c)

Additional Facts Concerning Welded Bridge Near Lowicz, Poland. STEFAN BRYLA. *Welding*, Vol. 1, Oct. 1930, pages 835–837.

The Polish Ministry of Public Works has prepared a set of specifications for arc welded structures which are the first official specifications for such structures in the world. The total weight of the bridge is 55 tons, as against 70 tons had it been riveted. W(11c)

Problems Met Putting Welding into a Shop. J. B. ROSE. *Welding*, Vol. 1, Jan. 1930, pages 173–177.

The author, a major in the Ordnance Dept. U. S. A., relates the experiences at the Watertown Arsenal, Mass., where the general set-up is designed for production and experimental welding. W(11c)

Joining Light-Gage Sheet Metal by Arc Welding. T. E. JERABEK (Lincoln Electric Co.). *Iron Age*, Vol. 126, Nov. 6, 1930, pages 1309–1310.

Use of electric arc welding in joining sheet metal of No. 14 gage and heavier may be done by using regular metallic or carbon electrodes. With metal lighter than No. 14 gage, and as thin as No. 22 gage the "lightweld" process is used. This process may be used for butt, corner or lap welds on material of No. 16, 18, 20 and 22 gage. Speed of welding on light gage depends on type of joint, gage of material and the set-up. Chief advantage of "lightweld" is that both vertical and overhead welding can be done. VSP(11c)

Automatic Arc-Welding Economies. G. H. KOCH (Westinghouse Electric & Manufacturing Co.). *American Machinist*, Vol. 73, Oct. 16, 1930, pages 621–623.

Discussion of the economic advantages of automatic arc-welding over manual arc-welding. RHP(11c)

Electric Welding. E. W. LEWIS. *Electrical Review*, Vol. 107, Oct. 17, 1930, pages 614–616; Oct. 24, 1930, pages 684–685.

Survey of recent developments such as the production of ductile welds, study of arc phenomena, automatic control, atomic-hydrogen welding, and application to marine, building, railway and bridge construction, chemical equipment and boiler manufacture. MS(11c)

Methods and Machines for Resistance Welding. R. T. GILLETTE (General Electric Co.). *American Machinist*, Vol. 73, July 31, 1930, pages 193–195.

Paper presented before the American Welding Society, New York, Mar. 11, 1930. Published in Journal of the American Welding Society, Vol 9, July 1930, pages 77–82 under the title of Resistance Welding. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 851. RHP(11c)

Welding of High-Pressure Pipe Lines. (Schweissen von Hochdruck-Rohrleitungen.) G. GOHLKE. *AEG Mitteilungen, das Kraftwerk*, No. 1, Jan. 1931, pages 9–14.

Recent experience has shown that it is quite feasible to join high-pressure steam line pipes by welding. Advantages of and conditions for the application of such joints are discussed and several methods are described and illustrated. The result of welding is greater safety in operation, reduced heat losses through leaks, simpler lines and reduced maintenance costs. Ha(11c)

Development and Present Status of Welding Rails. (Die Entwicklung und der Gegenwärtige Stand der Schienenschweissung.) M. REITER. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1585–1587.

Abstract of an article in *Organ für den Fortschritt im Eisenbahnwesen*, Vol. 85, 1930, pages 398–405, 419–432. The various methods of welding rails are discussed in the first part of the series of articles. The second part deals with the normalizing of welded rails. The results of the following physical tests are given: tensile tests, cold bending tests, impact bending test, notch toughness tests, endurance impact tests and hardness tests. All methods of welding rails need further improvement. GN(11c)

Manufacture of Electric Welded Pipe. U. A. PETERS. *Rolling Mill Journal*, Vol. 4, April 1930, pages 151–153.

Review of developments in the production of pipe by the electric seam welding. Considers resistance, arc, and roll-electrode methods. MS(11c)

Electric Arc Welding of Aluminum. W. M. DUNLAP. *Welding*, Vol. 1, Sept. 1930, pages 762–766; *Metal Industry*, N. Y., Vol. 28, Oct. 1930, page 470.

Abstract of paper read at fall meeting of American Welding Society, Sept. 22–26, 1930. Discusses application of arc-welding to Al and its alloys investigated by the Research Laboratories of the Aluminum Company of America. Also deals with welding technique and special applications of the process. VSP+AW(11c)

Welding of Iron Under Pressure. (Ueber die Pressschweissbarkeit des Eisens.) H. ESSER. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 199–206; *Stahl und Eisen*, Vol. 50, Oct. 23, 1930, page 1500.

The relation between weldability, temperature, pressure, surface and grain size of pure Fe was studied. In additional experiments, the weldability of C steels was also studied. The test specimens were heated within an electrically heated C spiral in vacuum and welded under pressure. The weldability was tested by tensile tests. The influence of the temperature was examined first. In order to eliminate the influence of the surface condition of the faces to be welded, all specimens were polished bright. The pressure was kept constant in this group of tests at 2 kg./mm.^{2} The weldability increased up to 900° C., decreased above this temperature and increased again later. The weldability increases with decreasing grain size, which probably must be traced back to the large number of favorably oriented crystallites present. In 3 groups of tests, the welding pressure was altered, amounting to 1, 2 and 3.5 kg./mm.^{2} The weldability increases with the pressure; the largest increase is shown when the pressure increases from 1 to 2 kg./mm.^{2} The surface condition plays an important role. The maximum values of weldability of polished specimens is reached at 970° C., whereas specimens prepared only on emery paper showed, depending on the grain of the paper, the maximum weldability at 1120° and 1280° C. respectively. The temperature range of good weldability decreases with increasing C content. The relations between temperature, strength of the weld, pressure and C content are illustrated in space diagrams. GN(11c)

Oxy-Acetylene Welding of Sheet Copper. A. EYLES. *Sheet Metal Worker*, Vol. 21, Nov. 28, 1930, pages 725–726, 732.

A practical discussion of the proper technique of oxy-acetylene welding of sheet copper with explanation of requirements for producing good joints. GN(11c)

Welding a 14-Story Building. J. L. FADEN. *Electrical World*, Vol. 96, Nov. 1, 1930, pages 824–829.

The Boston Edison Co's. new home has electric welding throughout. The welders were required to make lap-, fillet-, and butt welds and results of qualification tests are tabulated. Advantages realized by electric welding were: (1) construction noise was virtually eliminated; (2) cost of erecting and welding steel was $3/ton less than with riveted construction; (3) the accident hazard was greatly reduced; (4) fire hazard reduced by elimination of hot rivets; (5) progress of welded construction equalled speed of riveting; (6) welded building frame was more rigid than riveted; (7) alterations made necessary by errors or changes were more easily made than with riveted structure; (8) welding required simpler and less expensive stagings; and (9) smaller gussets were used for wind bracing than when riveting. Several illustrations and tables are included. WHB(11c)

Application of the Theory of the Electric Arc for Welding. (Die Anwendung der Lichtbogentheorie auf die Schweissung.) WILHELM FINK. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1557–1560.

The author points out what an important part the ionization of the air-gap between the electrodes has and discusses the theory of the arc in its bearing on the welding process. The different characteristics of direct current and alternating current arcs can be explained and the conditions for a steadily burning welding flame derived. It is explained that the transport of material in welding has no connection with the flow of electrons or atoms in the arc. Ha(11c)

Unsolved Problems in Structural Welding. GILBERT D. FISH. *Welding*, Vol. 1, May 1930, pages 453–454.

Brief discussion of the proper use of tension welds, secondary stresses in welded structures, and the practical problem of dividing welding between shop and field. ACW(11c)

Some Fundamentals of Redesign for Arc Welded Steel Construction. R. A. GAST. *Welding*, Vol. 1, April 1930, pages 397–398.

Gives method of making calculations and useful tables for redesigning a cast iron product for arc welded steel construction. To obtain the most efficient arc welded design the product must be redesigned to meet the physical requirements to which it is to be subjected, regardless of resultant shape. ACW(11c)

Welded Open Hearth Charging Machines. A. E. GIBSON (Wellman Engineering Co.). *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 796, 817–818; *Welding*, Vol. 1, Apr. 1930, pages 404–406.

Outlines the development of charging machines. With the advent of the very large units, it has been necessary to turn to welding as a means of fabrication. MS(11c)

Electric Welding. C. A. HADLEY (British Electric Welding Machines, Ltd.). *Electrical Review*, Vol. 107, Nov. 28, 1930, page 929.

Extracts from a paper read before the Associated Foremen Smiths of Scotland. Discussion of the process, with special reference to the automatic flash welding machine. MS(11c)

Electrode Research. M. HARAMIISHI. *Welding Journal*, Vol. 27, June 1930, pages 174–177.

Flux-coated and covered electrodes for metallic arc welding are considered. (11c)

Importance of Acetylene Welding in the Construction of Apparatus for the Chemical Industries. (Bedeutung der Azetylenschweissung für den Apparatebau der chemischen Grossindustrie.) H. HOLLER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1579–1584.

The chemical industry stands first in the use of welded joints in place of rivets and screws. This article shows a great many illustrations where repairs and alterations on metals other than Fe have been made by welding in a fully satisfactory manner. Ha(11c)

Some Requirements of Arc Welding. R. W. HOLT. *Sheet Metal Worker*, Vol. 21, Nov. 14, 1930, pages 686–688.

The importance of proper designing and preparation of the parent metal upon the efficiency of the results obtained is stressed in the article. GN(11c)

Three-Phase Arc-Welding. (Drehstrom-Lichtbogenschweissung.) HORN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1595–1596.

A symmetrical distribution of load on the 3 phases of a 3-phase system is obtained by connecting a high reactance in series with the welding transformer compared with the ohmic resistance of the welding circuit. Then, even with only one arc and 2 phases short circuited, the distribution of the current in the 3 phases will not be very different since the change in ohmic resistance is small compared with the impedance of the circuit. Ha(11c)

Welding of Rustless Steels Is Making Progress. L. W. HOSTETTLER (Allegheny Steel Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1376–1377.

Taken from a paper read before the American Welding Society. Gives data based on recent experiments. Straight Cr-Fe can be welded by any one of four methods. Light gage material can only be welded by spot weld methods. VSP(11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Conditions Determining the Action of Refining Agents in the Open-Hearth Furnace. (Abhängigkeitsbedingungen der Frischmittelwirkung im Siemens-Martin-Ofen.) E. KILLING. *Stahl und Eisen*, Vol. 49, Apr. 18, 1929, pages 527–531.

Report 164 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. 5 different Fe ores were used in the experiments to determine their relative values as decarburizing agents in the open-hearth process. The results confirm the theoretical conclusion that ores containing a higher amount of Fe_2O_3 are more efficient than those containing a higher amount of FeO. A high content of SiO_2 of the refining agent essentially decreases the economy. GN(12a)

Operation of Open-Hearth Furnaces. *Iron & Coal Trades Review*, Vol. 121, Aug. 8, 1930, page 189.

Abstract of discussion at the semi-annual meeting of the Open-hearth committee of the American Institute of Mining and Metallurgical Engineers, held at Buffalo, N. Y. RHP(12a)

Electrical Melting of Aluminum. (Das elektrische Schmelzen von Aluminium.) E. F. RUSS. *Zeitschrift für Metallkunde*, Vol. 22, Aug. 1930, pages 273–276.

Author recommends the utilization of electrical furnaces for melting of Al on account of advantages generally known and describes in detail his own designs brought on the market. EF(12a)

The Electrodynamic Motion in Induction Furnaces. (Die elektrodynamischen Badbewegungen bei Induktionsöfen.) E. F. RUSS. *Archiv für Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 277–280; *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, pages 1815–1816.

The author used, in his experiments on a U-shaped hearth induction furnace, a solid conductor to examine the motion of a liquid melt in such a furnace. All previous assumptions that there is a current in the liquid metal which is the cause of the formation of whirls are rejected. GN(12a)

Production of Die-Cast Automobile Parts. *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 59–60.

Over 50 gas-fired melting pots and die-casting machines are used in production of Al and white metal alloy parts for Lincolns and Fords. All machines operate at 7 lbs./in.^{2} pressure, and the temperature of the pots are 1250°–1400° F. The machines for white metal alloy operate at 1500–1600 lbs./in.^{2}, and the temperature of the pots is 720°–900° F. A cast-iron pot set in a brick foundation and heated with a single gas burner is used for making Pb solder. Solder is recovered from scrap in a gas-fired brick furnace, having the hearth at a 15° angle with the horizontal and concave from side to center. MS(12a)

Two New Methods for the Production of Electric Furnace Iron. G. L. SIMPSON. *Fuels & Furnaces*, Vol. 8, July 1930, pages 939–940.

Abstract of paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 736. MS(12a)

The Finishing of Refined Thomas Pig Iron in the Open Hearth Furnace. (Das Fertigmachen von vorgefrischtem Thomasroheisen im Siemens-Martin-Ofen.) A. JUNG. *Stahl und Eisen*, Vol. 49, Aug. 22, 1929, pages 1221–1226.

Includes discussion. Report 172 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Gives the results of investigations which were carried on for the purpose of studying the economics of the duplex method, i. e., the steel charge was first refined in the Thomas converter and finished in the open-hearth furnace. The metallurgical process was studied and the furnace capacity and fuel consumption determined. Rules for the economic considerations are outlined. GN(12a)

Cupola Melting of Bronze. E. R. DARBY. *Metals & Alloys*, Vol. 1, Nov. 1930, pages 812–813.

The use of the cupola or shaft type furnace for casting purposes is the result of very recent developments. It became possible with development of pitch coke by the Barrett Co. This fuel contains no ash, very little S, and better than 99% fixed C. The furnace and its operation are described in detail. Alloys containing up to 10% Pb may be melted. Cases as high as 20% have been successfully handled. However, in the latter instance, it is advisable to charge not in excess of what may be tapped into a single ladle. Alloy containing up to 5% Zn may be treated although losses are quite heavy. 85–5–5–5 bronze will lose over 60% of its Zn. The losses of Cu and Sn are negligible if the particles are not so small as to be carried away by the blast. P, free Fe and Al are almost entirely eliminated. Continuous operation of a furnace for 8 or 9 hours yields a fuel ratio of 1 to 14. With a fuel cost of $33.00 per ton, the melting cost is 12¢ cwt. ESC(12a)

A Contribution to the Problem of the Analysis of Basic Slags and the Representation of Their Composition in a Triangular Diagram. OTAKAR QUADRAT. *Engineering*, Vol. 130, Sept. 26, 1930, pages 404–405.

Abstract of paper read before the Iron & Steel Institute, Prague, Sept. 15, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. LFM(12a)

The Decarburization of Iron in the Open-Hearth Furnace and the Concentration of Free Ferrous Oxide in Basic Slags. HERMAN SCHENCK. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 674–677.

A translation. The law of mass action is applied to the open-hearth system on the basis that the C content of the metal must of necessity bear a relation to the concentration of the free FeO. Various conceptions of the value to be used for the constant (FeO) are discussed. It is only possible to ascertain a relation between C content and FeO concentration if part of the Fe contained in the slag is considered as being combined in the form of lime ferrite. Evidence is presented to indicate these data and may be used to judge the heat for the quality of steel. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 736. ESC(12a)

Continuous Electric Melting of Cast Iron. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 672–673.

A correlated abstract. Two new methods for operating the electric furnace to give a continuous flow of metal during the working day have recently been developed. In the continuous duplexing process, the metal is melted in the cupola with just as little coke as will make it run properly and fed into the electric furnace where materials are added to give the desired composition, and the metal is superheated to the desired temperature. A full bath is maintained in this furnace and at regular intervals a batch of refined and superheated iron is tapped off. The continuous melting process utilizes the electric furnace alone. The charge is melted, the composition corrected, the temperature raised to the desired value and a small ladle of molten metal tapped off. Immediately, the equivalent amount of cold metal is charged through the rear door of the furnace. In both processes the furnace load is discharged at the end of the day's work. A 3-ton electric furnace installation in continuous operation has shown 25–30% increase in production, reduction of cost, and greater flexibility to cope with rush orders. Data are given regarding costs. The melting practice is readily adapted to desirable results. The feed charges consist of foundry returns and stove plate scrap without additional alloys. ESC(12a)

Drawing & Stamping (12h)

Standard Brake Dies of Simple Design. Parts VI–IX. GLENN A. BARTH (Barth Stamping & Machine Works). *Metal Stampings*, Vol. 3, Jan. 1930, pages 53–55; Feb. 1930, pages 147–148; April 1930, pages 339–340; May 1930, pages 439–440, 476.

Discusses construction of dies required for the formation of lock seams and the Pittsburgh lock; application, design, and operation of special brake dies; combination brake die; and adaptability of press brakes for piercing and notching operations. MS(12h)

Drawing Qualities of Sheet Steels for Automobiles. W. H. GRAVES (Packard Motor Car Co.). *Metal Stampings*, Vol. 3, May 1930, pages 443–444.

From paper read before American Society for Testing Materials. See *Metals & Alloys*, Vol. 1, July 1930, page 633. MS(12h)

The Manufacture of Solid Drawn Gunmetal Tubes. EDWARD S. RICHARDS. *Metal Industry*, London, Vol. 37, Aug. 8, 1930, page 133.

Solid drawn gunmetal tube making presents many difficulties. Describes the manufacture of a solid drawn gunmetal tube of the following analysis:

Sn	4%
Pb	2%
Zn	5%
Cu	88% to 89%
Fe	Nil.

VSP(12h)

Power Consumption and Physical Properties in Drawing Low Carbon Steel with Increased Speed. (Kraftverbrauch und Werkstoffeigenschaften beim Ziehen von Stahldraht mit erhöhter Ziehgeschwindigkeit.) A. POMP & W. BECKER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 161, pages 263–284; *Stahl und Eisen*, Vol. 50, Dec. 4, 1930, pages 1723–1724.

Three steels, as listed below, were drawn with gradually increased speed, to study the power consumption and the influence of the structure:

Material	C%	Si%	Mn%	P%	S%
A: Open hearth steel	0.065	..	0.33	0.026	0.046
B: Thomas steel	0.080	..	0.39	0.054	0.040
C: Silicon open hearth steel	0.070	0.25	0.41	0.009	0.060

These steels were drawn partly direct down from the rod (5.3 mm.) and partly drawn down to 3 mm. wire, pot annealed at 850° to 900° C. and drawn to 1.8 mm. wire. The drawing speed was increased from 2.3 to 7.5 m./sec. At the higher speeds, the power consumption decreased by about 5%. The power consumption figures obtained were used to plot diagrams in order to predetermine for any wire the power consumption of the subsequent draft. Drafting with increased speed did not impair the physical properties of the wire as determined by tensile tests, elongation, reduction of area, bending and twist tests. The life of the dies, as determined by the tonnage drawn, was in most cases longer for the high speed than for the slow speed. The only difficulties encountered in drawing with increased speed results from stringing. GN(12h)

Press Working and Forming of Metals. Parts XX, XXII–XXIX. E. V. CRANE (E. W. Bliss Co.). *Metal Stampings*, Vol. 3, Jan. 1930, pages 27–33; March 1930, pages 221–226, 248; April 1930, pages 313–319; May 1930, pages 413–418; June 1930, pages 521–526; July 1930, pages 629–632, 652; Aug. 1930, pages 725–726; Sept. 1930, pages 811–814; Oct. 1930, pages 887–890.

Deals with multiple drawing dies and operating problems involved in metal working operations; volume changes, flow of metals, and pressures involved in squeezing operations; squeezing operation involved in the cold sizing and surfacing of stampings, forgings, and castings; changes of yield-point with cold working of metal, and cold forging operations, especially in soft steel and Cu; typical cold swaging operations in these metals; developments in coinage practice; characteristics and typical applications of embossing operations in sheet-metal; and typical applications and methods of press extrusion. Compression tests were carried out on 2 blanks, $^3/_4$ in. in diameter and $^1/_2$ in. high, of machine steel with 0.15% C. The yield-point in compression rose from 37,000 lbs./in.^{2} in the annealed state to 115,000 lbs./in.^{2} when reduced to half the original thickness. The Brinell hardness number rose from about 120 to approximately 240. Re-annealing reduced the yield-point to 45,000 lbs./ in.^{2} and further compression again raised it to 95,000 lbs./in.^{2} Part XXI was abstracted in *Metals & Alloys*, Vol. 1, July 1930, page 634. MS(12h)

Polishing & Grinding (12l)

Polishing Stainless Steel and Rustless Iron. L. R. EASTMAN (Frederic B. Stevens, Inc.). *Metal Cleaning & Finishing*, Vol. 2, March 1930, pages 221–225.

Small parts are polished in one operation with a No. 200 or flour size abrasive. In some cases, a No. 180 abrasive may be necessary followed by the 200 wheel. Larger areas of flat or nearly flat surfaces are polished with a No 150 dry, then a 180 tallow, and finally a 200 tallow wheel. Still larger surfaces require a No. 180 artificial, dry; 180 emery, dry; 180 artificial with tallow; then 200 emery, with grease. The buffing abrasive must be hard and fine enough to produce a high finish, and the binder must be capable of holding the abrasive on the wheel and lubricating the buff. High, uniform pressures and a peripheral speed of about 10,000–12,000 ft./min. are necessary for buffing. A composition similar to the buffing compound, but usually dryer and with less cutting qualities is generally used for coloring. MS(12l)

DEFECTS (13)

The Nature of the Flakes in the Chrome-Nickel and Chromium Steels. A. L. BABOSHIN. *Metallurgist* (Leningrad, Russia), No. 2, 1929, pages 206–215. (In Russian.)

Taking into consideration all the data in literature and the results of his own observations, the author comes to the following conclusions: (1) flakes are only observed in those steels (a) in which the location of critical points depend to a great extent upon the rate of cooling and the temperature of heating, or (b) which show a well pronounced dendritic structure—a great majority of such steels are Cr-Ni, Mn, and Cr steels; (2) the principal factor (beside composition) determining the appearance of flakes are cooling conditions of metal (ingots, forgings, etc.); (3) cracks (flakes) are caused by stresses resulting from (a) the sudden changes in volume during the normal cooling conditions, or (b) non-uniform cooling of the outer and inner portions of forgings; (4) all the conditions promoting the factors cited in (1) and (3) or reducing the resistance of metals to the internal stresses promote the formation; in particular, larger Cr and Mn contents of the Cr-Ni steels of a normal composition, other conditions being equal, promote the presence of flakes; insufficient deoxidation of metal or impurities as well as blowholes also promote flakes. AIK(13)

Tracing the Cause of Defects. ALBERT J. BOND. *Foundry*, Vol. 58, June 15, 1930, page 75.

Describes method of tracing defects. Pressure castings often show high % of leaks under test. These are caused by sand holes, flakes of oxide or shrink cracks. Defects in flanged castings were due to failure of metal to cover the core on casting. Using good cores and careful molding, sound castings are produced. Cites other examples of defects and their causes. VSP(13)

Non-Metallic Inclusions in Iron and Steel. C. BENEDICKS & H. LÖFQUIST. John Wiley & Sons, New York, 1931. Cloth, 6 × 9 $^3/_4$ inches, 311 pages. Price $8.00.

This book covers work at the Swedish Metallographic Institute done in part on a scholarship, presented by Sir Robert Hadfield, and in part with the financial support of Jernkontoret, the Swedish Iron Masters' Association. It is largely the result of a survey of the literature and contains some 800 references. The meticulous care taken to state in the text, in parenthesis and italics, the name of each worker to whom is due a fact or an opinion ought to delight the British reviewers who are so touchy when anyone cites a fact that may have been unearthed by some British worker, among others, without pausing to give detailed credit every time it is mentioned. Nevertheless, this constant breaking up of the text is irritating to the eye and makes it more difficult to follow the argument.

The equilibria between iron and the various constituents of the non-metallic inclusions are considered in detail, as are the binary and ternary diagrams for oxides, sulphides, silicates, etc., in the slags themselves.

The properties of some 20 materials that may occur as non-metallic inclusions are given in a large table. Much attention is paid to the Campbell-Comstock-Wohrman scheme for metallographic recognition of the constitution of inclusions. Chemical methods for quantitative analysis are mentioned in less detail.

The mechanism of the formation and the release or retention of inclusions in melting and pouring processes, the distribution of the inclusions during crystallization, and the general problems of segregation, blowhole formation, banded structure and flakes are relatively briefly discussed.

The effect of inclusions on mechanical properties is given a dozen pages.

The practical suggestions as to possible means of reducing the content of non-metallic inclusions, given in the last half-dozen pages, in general, accord fairly well with the trend of Herty's investigations.

The general impression one gets from the book is that a vast amount that ought to be known for a fully intelligent attack on the problem of non-metallic inclusions has still to be found out. This critical compilation of the results of the large amount of work already done and recorded in many thousands of pages in the original papers will be of service to those interested in the problem.—H. W. Gillett (13)-B-

CHEMICAL ANALYSIS (14)

Determination of Carbon in High Sulphur Steels by Direct Combustion. H. A. BRIGHT & G. E. F. LUNDELL. *Bureau of Standards Journal of Research*, Vol. 5, Oct. 1930, pages 943–949.

Oxides of sulphur are formed in the direct combustion method for carbon in steel and cause positive errors if they are not removed. The absorbents commonly used for this purpose, as well as promising new ones, have been tested. A description is given of the absorption train that has been developed at the National Bureau of Standards as well as one that has been developed by the Jones & Laughlin Steel Co. (14)

The Analytical Chemistry of Element 91, Ekatantalum, and Its Difference from Tantalum. ARISTID V. GROSSE. *Journal American Chemical Society*, Vol. 52, May 1930, pages 1742–1747.

The unsuccessful attempts to isolate and obtain element 91 were based on the assumption that it resembles its lower homolog-tantalum—just as radium resembles barium. This article describes the analytical chemistry of ekatantalum and verifies the predictions of Mendelejeff's law. The behavior toward different reagents is in most of the cases observed, opposite to that of tantalum. Ekatantalum pentoxide is a distinctly, though feebly, basic oxide without acidic properties, whereas tantalum pentoxide is an acid anhydride and readily forms stable salts with basic oxides. MEH(14)

The Importance of Particle Size in Samples of Certain Metallurgical Materials. J. A. SCHERRER & G. E. F. LUNDELL. *Bureau of Standards Journal of Research*, Vol. 5, Oct. 1930, pages 891–895.

The sampling of certain metallurgical materials gives rise to particles that differ in size and in composition. The extent of the difference is shown and the procedures that must be followed in selecting the sample for analysis are outlined. (14)

Quantitative Spectrum Analysis by X-Rays. (Quantitative Spektralanalyse mit Röntgenstrahlen.) G. V. HEVESY. *Metallwirtschaft*, Vol. 9, Sept. 26, 1930, pages 801–804.

Contains 12 references. Minerals and metals can be analyzed quantitatively by examining their spectrum with X-rays. The intensity of the characteristic line of an element depends on the other elements present. The percentage of an element is determined by mixing a known quantity of another element with the unknown sample and comparing the intensity of its line. This element must not already be present in the sample. Rare elements such as Hf are usually used. The intensity of the line to be determined and of the line of the comparison element must be influenced to the same degree by other elements present in the sample. The suitability and limitations of various elements for comparison purposes are discussed. Examples are worked out for determining (1) Ti in iron meteorites, (2) Small percentages of Pb in Zn, (3) K in soils and (4) Nb and Ta in volcanic minerals. CEM(14)

A Rapid Method for the Determination of Antimony in a High Copper Alloy. JOHN B. KASEY. *Chemist-Analyst*, Vol. 19, Sept. 1930, page 9.

The sample is dissolved in HNO_3, HCl mixture and an excess of NH_4OH added. $(NH_4)_2CO_3$ and paper pulp are added and the solution filtered. The bulk of the Cu remains in the filtrate. The precipitate is dissolved in H_2SO_4 and HNO_3, tartaric acid is added and the solution heated until it turns amber color. Pass in H_2S to precipitate Sb and fume to SO_3. Add $KHSO_4$ and after boiling out H_2O add pure S and fume for $^1/_2$ hour. Cool, dilute, add HCl and titrate with $^1/_{10}$ N $KMnO_4$. If As is present, separate by Stief method before titrating. CEM(14)

Quantitative Analysis of Iron Alloys by Means of X-Ray. SHIGETAKA SHIMURA & MASAO TAKASU. *Tetsu to Hagane*, Vol. 16, Sept. 25, 1930, page 961–970.

The article deals with quantitative analysis of Fe-Ni-Mn alloys by means of radiation spectrum. The 4 alloys used in this study were prepared in an electric furnace using electrolytic iron, metallic manganese and metallic nickel. These alloys contained 3.6–13% Mn, and 3–10% Ni. The characteristic X-Ray was produced by Hadding tube, analyzed with a spectrograph and then exposed to a dry plate. The intensity of the K-series lines was measured by a Noll's microphotometer, and from the values thus obtained the contents of Mn and Ni were calculated. The results obtained often differed widely from the actual contents; that is 0–25% errors for Mn and 0.5–15% for Ni. The authors added that this error will be reduced by replacing plates used and by more skilful manipulation of photometer. TS(14)

The Importance of Sampling in the Metal Industry. (Die Bedeutung der Probenahme für den Metallhandel.) WILHELM KLUTE. *Metallwirtschaft*, Vol. 9, Jan. 17, 1930, pages 72–73.

Since the war the use of secondary metals has increased. The success or failure of their use depends on proper sampling. Analyses on duplicate samples should check within $^1/_2$%. Experienced samplers are necessary. Price of secondary metals is often based on analysis of samples. CEM(14)

Physico-Chemical Measurements (Hand- und Hilfsbuch zur Ausführung physikochemischer Messung). C. DRUCKER. 5th Edition of the Ostwald-Luther Handbook. Akademische Verlagsgesellschaft, Leipzig, 1931. Cloth, 6 × 9 1/2 inches, 979 pages. Price 52 RM.

The first edition of Ostwald's handbook was issued in 1893 and has been used by many generations of college students. The fourth edition came out in 1925. While all chapters have been revised and expanded by Drucker and a group of able collaborators, the chief addition is in regard to the use of electron tubes.

Drucker points out that many old methods of and devices for physico-chemical measurements are as worthy of description and use as some more modern and complicated ones, and in fact, are often more simple and much cheaper. Hence a large part of the book is not essentially different from the old Ostwald-Luther the reviewer used 25 years ago.

The field covered is so very wide that a detailed coverage would be out of the question. Drucker has wisely chosen to deal with principles and with the simpler types of apparatus rather than to cover highly refined and specialized equipment. Fairly full references are given, through which more detailed information can be found, but on the whole the handbook seems designed to cover such apparatus as is required in undergraduate laboratory courses in physico-chemical measurements rather than in advanced research work. In the treatment of calorimeters, thermostatic control, high vacua, and laboratory electric furnaces, for example, necessary details on special apparatus necessary for refined work may be traced only through the footnote references, if at all. The type of equipment built up chiefly by the glass blower is rather thoroughly dealt with, but mechanical and electrical equipment such as chronographs, oscillographs, potentiometer controllers, etc., scarcely receives mention. The physical chemist dealing with aqueous solutions will find a great deal of value in the book. The physical metallurgist will find something of value but will not find information on a very large proportion of the types of measuring equipment he needs for advanced work. A notable exception is, however, the fact that the elements of X-ray spectrography are discussed.

Within its limitations, the volume is a very valuable handbook.—H. W. Gillett (14)-B-

Sampling for the Determination of Average Metal Content of Ores. (Ueber Probenahme zur Ermittlung des Durchschnittsmetallgehaltes von Roherzen & des Aufbereitungserfolges.) JOHN E. BARNITZKE. *Metall und Erz*, Vol. 27, Feb. 1930, pages 53–66; April 1930, pages 179–187.

The difficulties of obtaining a true average in sampling ores are pointed out. Instructions are given for the best procedure and the theory for sampling well mixed and unmixed ore is discussed. The methods of taking large quantities at longer intervals and small quantities at shorter intervals are compared. The conditions for a representative sample are stated. The probable percentage error should be known. The methods of sampling formerly used are not reliable. CEM(14)

HISTORICAL & BIOGRAPHICAL (15)

When Forging Was Young. CHESTER B. LORD. *American Machinist*, Vol. 73, Sept. 18, 1930, pages 467–470.

Historical review. Deals sketchily with various ancient steels and methods of working. Hand hammering is given much credit for the quality of the ancient steels. RHP(15)

Furnaces in the Hanging Rock District. H. H. HOPKINS. *Blast Furnaces & Steel Plant*, Vol. 18, Sept. 1930, pages 1451–1452.

Outline of the history of blast furnaces, now dismantled, near Ironton, Ohio. MS(15)

Heat Treatment of Ancient Implements. H. C. H. CARPENTER & J. M. ROBERTSON. *Heat Treating & Forging*, Vol. 18, July 1930, pages 869–871, 875.

From a paper "Metallography of Some Ancient Egyptian Implements," read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Sept 1930, page 739. MS(15)

ECONOMIC (16)

Gold and Silver in 1928. J. P. DUNLOP. *Mineral Resources of the United States*, 1928, Part 1, *United States Bureau of Mines*, November 6, 1930, pages 873–910.

Gold was produced in 18 states, Alaska and the Philippine Islands in 1928, to a total amount of 2,233,251 fine ounces. California led with 513,249 ounces, Alaska was second with 330,604, and South Dakota third with 318,095. This represented an increase of 36,126 ounces over 1927. California showed the greatest decrease (51,732 ounces) among 6 decreasing state productions and Alaska the greatest increase (44,306 ounces). Silver totaling 58,462,507 fine ounces was produced in 20 states, Alaska and the Philippine Islands in 1928. Utah led with 17,749,317 ounces, Montana was second with 10,681,675 and Idaho third with 8,949,716. This represents a decrease of 1,971,934 ounces. Utah showed the greatest drop in production (1,604,441 ounces) and Texas the biggest increase (451,694) among 10 states increasing output. Arts and manufactures used 68% of the new gold and 43% of the new silver. Figures are given for world production by countries for 1923 to 1928. AHE(16)

Platinum and Allied Metals in 1929. HUBERT W. DAVIS. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, October 28, 1930, pages 57–71.

Mine production of crude platinum in the United States in 1929 was 797 ounces, 528 from Alaska, 246 from California and 23 from Oregon. Production in 1928 was 528 ounces. Refinery recovery of platinum metals in 1929 was as follows: platinum 41,760 ounces, palladium 5295, iridium 302, osmiridium 364, others 256, total 47,977, a decrease of 18% from 1928. Of this, 10,886 ounces was derived from domestic sources. Secondary metals in this group in 1929 totaled 42,759 ounces. World production and occurrence by countries are discussed. AHE(16)

Iron Ore, Pig Iron and Steel in 1929. HUBERT W. DAVIS. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, October 22, 1930, pages 5–44.

In 1929 the production of iron ore (73,027,720 tons) increased 17% over 1928; the output of pig iron, including ferro-alloys (42,613,983 tons) increased 12%. Iron ore was mined in 18 states, Minnesota leading with 45,760,858 tons, Michigan being second with 15,456,397 and Alabama third with 6,453,075 tons. Pig iron (plus ferro-alloys) was produced in 18 states, Pennsylvania leading with 14,453,251 tons, Ohio being second with 9,795,648 and Illinois third with 4,357,971 tons. Ferro-alloy production increased 4% to 829,324 tons. Steel output increased 9% over 1928 to 56,433,473 tons. Of this, 85.7% was open hearth, 12.6% Bessemer, and 1.7% other classes. AHE(16)

Iron and Steel in Canada. *Iron & Coal Trades Review*, Vol. 121, Aug. 1, 1930, page 156.

Abstract of a report of F. W. Field on "Economic Conditions in Canada" (to May 1930). Discusses imports, production, railway equipment and shipbuilding. RHP(16)

Coal and Iron in Belgium in 1929. *Iron & Coal Trades Review*, Vol. 121, July 18, 1930, page 88.

Abstract of the report by N. S. Reyntiens in his Report on Economic Conditions in Belgium in 1929, issued by the Department of Overseas Trade of England RHP(16)

Cost System in the Heat Treating Plant. J. J. BERLINER. *Heat Treating & Forging*, Vol. 16, May 1930, pages 614–616.

Outlines system of determining the costs of the various heat-treating operations MS(16)

Coke and Iron in Sweden. *Iron & Coal Trades Review*, Vol. 121, July 11, 1930, page 48.

Abstract of a report on "Economic Conditions in Sweden," by W. J Glenny issued by the Department of Overseas Trade and published by H. M. Stationery office. RHP(16)

Iron and Steel Imports and Exports in the First Half of 1930. *Iron & Coal Trades Review*, Vol. 121, July 18, 1930, page 85.

Reviews the imports and exports by months for Jan.–June 1930. By product and by country for 1913, 1929, and Jan. to June 1930. RHP(16)

Engineering Markets of the World. V. A. J. LIVERSEDGE. *Engineering*, Vol. 130, Oct. 10, 1930, pages 452–454.

Review of import situation in British Africa. Commodities discussed include iron and steel and manufactures thereof, electrical apparatus, machinery, railway plant and stock, and motor vehicles. Although the Union of South Africa gives preference to British made goods, imports from the United Kingdom are steadily falling off. In iron and steel Germany is England's chief competitor, Belgium is second and U. S. third. Figures and curves show imports from 1913 to 1929. Curves for all commodities from United Kingdom end on lower levels than where they began in 1913 and are also lower than they were in 1925. LFM(16)

Cost Calculations of Light Metal Castings. (Kostenaufstellung bei Leichtmetallguss.) W. HOFFMANN. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, page 25.

Author developed a formula and gives diagram to calculate cost of castings of various metals and alloys with particular reference to light metal castings. EF(16)

Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1929. J. P. DUNLOP. *Mineral Resources of United States*, 1929, Part I, *United States Bureau of Mines*, November 12, 1930, pages 73–78.

The mines of the Eastern States yielded metals in 1929 valued as follows: Au, $36,793; Ag, $59,515; Cu, $5,992,082; and Zn, $21,920,456. Both the quantity and value of all 5 metals except Ag, increased in 1929 over 1928. AHE(16)

Magnesium and Its Compounds in 1929. PAUL M. TYLER. *Mineral Resources of United States*, 1929, Part II, *United States Bureau of Mines*, Nov. 20, 1930, pages 119–138.

The domestic output of virgin ingot increased from 521,075 lbs. in 1928 to 1,329,669 lbs. in 1929 (155%). Much progress has been made in the development of extrusion, forging and other fabrication methods. AHE(16)

Copper in 1928. C. E. JULIHN & H. M. MEYER. *Mineral Resources of the United States*, 1928, Part 1, *United States Bureau of Mines*, Oct. 6, 1930, pages 705–759.

In 1928, world Cu production (1,878,000 short tons) was supplied as follows: United States, 53.49; Chile, 16.31; Belgian Congo, 6.60; Japan, 3.87; Canada, 3.32; Peru, 3.07; Germany, 2.85; Mexico, 2.29; Spain, 1.63; Great Britain, 1.35; Russia, 1.17; and other countries 4.05%. This was an increase of about 12% over 1927, only 4 countries having decreasing productions. The United States and 5 other countries dropped in their % of the world's total (U. S., 2.07%). Cu production in the United States increased 8.01%. Trends are indicated by Canada's increase of 77% over 1927, Chile 23% and Congo 26%. AHE(16)

PLANTS & LABORATORIES (17)

Sheet Metal Enameling Process Mechanized. C. B. PHILLIPS (Surface Combustion Co.). *Ceramic Age*, Vol. 15, May 1930, pages 281–282.

Describes the installation for vitreous enameling of sheet metal at the Harvey, Illinois, Plant of the American Stove Company. WLC(17)

Heat Treating Motorcycle Parts. C. B. PHILLIPS (Surface Combustion Co.). *Iron Age*, Vol. 126, July 24, 1930, pages 221–224.

Describes heat treating equipment of Harley-Davidson Motor Co., Milwaukee. A continuous furnace which can be used interchangeably for various kinds of heat treating is used. Carburizing is done in batch-type furnace. Insulation of continuous furnace is inside steel casing. Miscellaneous hardening is done in a rotary type furnace provided with both an oil and water quench. Gas fuel is employed. VSP(17)

Heat-Treating Alloy Steel Airplane Parts. C. B. PHILLIPS (Surface Combustion Co.). *Machinery*, Vol. 35, Aug. 1929, pages 943–945.

Describes the heat-treatment work of the Fairchild Airplane Mfg. Corp., Farmingdale, Long Island, N. Y. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 388. RHP(17)

Battelle Memorial Institute. R. RIMBACH. *Metals & Alloys*, Vol. 1, Oct. 1930, pages 770–774.

The Battelle Memorial Institute was founded by Gordon Battelle to provide for carrying on pure and industrial research. It is a non-profit making organization, so industrial projects are merely self-supporting. The building is attractively constructed and provides generous space for future development. The library promises to compare favorably with the best of its kind. A brief discussion of activities now in progress is offered. ESC(17)

The New Research Laboratory of the Aluminum Co. of America. R RIMBACH. *Metals & Alloys*, Vol. 1, Sept. 1930, pages 717–720.

A detailed description is given of the structure, arrangement and equipment of the New Kensington laboratory of the Aluminum Co. of America. A number of photographs are included. ESC(17)

The Research Laboratories of the New Jersey Zinc Co. RICHARD RIMBACH. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 13–17.

A description of that portion of the Research Division of the Technical Department of the New Jersey Zinc Co. which is devoted to metallurgical studies. A number of photographs are included showing equipment utilized for this work. ESC(17)

New Buttweld Pipe Mill Equipped with Regenerative Furnace. F. B. PLETCHER. *Iron Trade Review*, Vol. 86, May 8, 1930, pages 52–55.

Describes plant of the Laclede Tube Co., Alton, Ill. Includes galvanizing and enameling equipment. MS(17)

The Basic-Bessemer Steelworks of the Mannesmann Tube Works. J. POSTINETT. *Iron & Coal Trades Review*, Vol. 121, Aug. 29, 1930, pages 292–293; Sept. 5, 1930, pages 326–327.

Taken from *Stahl und Eisen*. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 854. RHP(17)

Completes Third Hot Strip Mill. J. B. PLETCHER. *Iron Trade Review*, Vol. 86, March 20, 1930, pages 41–44.

Illustrations with brief description of the new continuous unit of the Acme Steel Co. at Riverdale, Ill. MS(17)

Rolling Wire for the Hudson River Bridge. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, Aug. 1930, pages 1280–1284.
Describes equipment, particularly the rolling mills, of the Kinkora Plant of the John A. Roebling's Sons Company at Roebling, N. J. MS(17)

Inland's 10-in. Mill Goes into Operation. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1599–1601.
Describes new continuous merchant bar mill and accessory equipment of the Inland Steel Company, Indiana Harbor, Ind. MS(17)

Hot Strip Mill at Acme Steel Company. A. F. KENYON (Westinghouse Electric & Mfg. Co.). *Blast Furnace & Steel Plant*, Vol. 18, Aug. 1930, pages 1297–1301.
Describes continuous mill at Riverdale, Ill., with particular emphasis upon the electrical drives and controls. MS(17)

Line Production the Keynote of New Pratt & Whitney Aircraft Plant. J. W. MARSHALL. *Iron Age*, Vol. 126, July 17, 1930, pages 152–155, 202–203.
Describes new $2,000,000 plant at East Hartford, Conn., for the manufacture of Wasp and Hornet Motors. Main factory building is 1000 ft. long with 400,000 sq. ft. of floor area. All Al parts are machined in one part while steel in another. Tool room and master crib are centrally located. Assembled engines are tested and then torn down for inspection. Plant addition can be made without interruption of production. VSP(17)

Apply Continuous Process to Malleable Practice. B. R. MAYNE (Saginaw Malleable Iron). *Foundry*, Vol. 58, May 15, 1930, pages 61–64, 90.
A steady supply of metal is essential in continuous molding operation. Describes plant of Saginaw Malleable Iron at Saginaw, Michigan. Melting equipment consists of three 90-in. shell cupolas; three 10-ton oval shaped fore-hearths; one 3-ton electric crane and two 3-ton electric furnaces. Metals at cupola average 2800° and electric furnace 2950° F. VSP(17)

Oil Fired Batch Type Furnaces Used in Annealing Aluminum Sheets and Strip. *Fuels & Furnaces*, Vol. 8, Feb. 1930, pages 261–262.
United States Aluminum Co., Edgewater, N. J., has installed 4 new batch furnaces with one double-pass firing chamber located on each side of furnace and has remodeled 4 furnaces with Carbofrax top on firing chamber. Furnace temperature of about 900° F. is maintained. Duration of heat depends on various factors and ranges from 2–18 hrs., with an average of about 4 hrs. MS(17)

Aluminum Invades the Structural Field. *Chemical & Metallurgical Engineering*, Vol. 37, March 1930, page 143.
Brief description of the rolling-mill at the Massena, N. Y., plant of the Aluminum Company of America. MS(17)

Plating Department Design at Crosley. D. W. MACDONALD. *Metal Cleaning & Finishing*, Vol. 2, June 1930, pages 477–482, 528.
Describes plant layout, equipment, and plating procedure of the Crosley Radio Corporation. MS(17)

Heat Treatment of Motorcycle Parts. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1041–1044.
Describes equipment and practice of the Harley-Davidson Motor Co., Milwaukee, Wis. Among the steels used are S. A. E. 3115, 3140, and 3245. Furnaces include batch type carburizing furnace, continuous automatic furnace used interchangeably for various kinds of heat treating, periodic furnaces for miscellaneous work, lead pots, cyanide pots, and rotary type hardening furnace. MS(17)

Interesting Installation for Production of Galvanized and Japanned Strip Steel. *Fuels & Furnaces*, Vol. 8, July 1930, pages 917–921.
Describes plant of the Acme Steel Company at Riverside, Ill. Strip is annealed in a Pb bath, pickled and galvanized, or annealed and japanned in continuous type equipment. MS(17)

A large Italian Electric Steel Making Plant. (Une grande usine electro-siderurgique italienne.) *Journal du Four Electrique*, Vol. 39, Sept. 1930, pages 339–340.
Vulcano Works at Sesto San Giovanni recently completed the installation of a series of electric furnaces of conducting bottom type. Six rated at 1500 KW and one at 750 KW are used for preparation of ferro alloys. They are monophase type. Three-phase furnaces rated, respectively, 3500 and 5000 KW are used here for refining of cast iron and foundry work. They employ Soederberg continuous electrodes. JDG(17)

Furnaces and Mills at Apollo Steel Co. A. L. HOLLINGER (Surface Combustion Co.). *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1607–1610.
Description of equipment in the plant at Apollo, Pa. Comprises 4 gas-fired, automatic, walking-beam type pair furnaces, 3 pack furnaces of similar design and construction, normalizing furnace, 11 box-annealing furnaces and galvanizing furnaces. MS(17)

Steel Foundry Centralizes Operations. NORMAN F. HINDLE *Iron Trade Review*, Vol. 86, Jan. 16, 1930, pages 37–41, 92.
Describes operations of the Farrell-Cheek Steel Foundry Co., Sandusky, Ohio. MS(17)

Metallurgical Laboratories. CARLE R. HAYWARD. *Mining & Metallurgy*, Vol. 11, May 1930, pages 252–254.
Presented before a session of the committee on engineering education, American Institute of Mining Engineers, Feb. 1930. Gives the general aspects of college laboratory work. Describes the laboratories of the Massachusetts Institute of Technology. VSP(17)

Metallurgy for Wasps and Hornets. JOHN HAYDOCK. *American Machinist*, Vol. 73, July 31, 1930, pages 189–192.
Description of the recently completed heat treating and metallurgical departments of the Hartford plant of the Pratt and Whitney Aircraft Co. They have 6 divisions: (1) chemical laboratory and balance room; (2) physical laboratory; (3) photographic and microscopic section; (4) furnace room; (5) etching and plating room; (6) inspection department. Lists and describes location of the equipment. RHP(17)

Exemplary Adaptation of Aluminum to Construction. JUNIUS D. EDWARDS (Aluminum Company of America). *Chemical & Metallurgical Engineering*, Vol. 37, July 1930, pages 428–429.
Describes the uses to which Al and its alloys are put in the research laboratories of the Aluminum Company of America. See article in *Metals & Alloys*, Vol. 1, Sept. 1930, pages 717–720. MS(17)

Special Equipment Speeds Output in New Steel Foundry. EDWIN F. CONE. *Iron Age*, Vol. 126, Dec. 1930, pages 1683–1687.
Describes electric steel foundry of the Lebanon Steel Foundry. VSP(17)

Electric Heat Treating of Roller Bearings Reduces Costs. E. V. BLANCHARD (Bower Roller Bearing Co.). *Iron Age*, Vol. 127, Jan. 8, 1931, pages 172–175.
Describes installation of Bower Roller Bearing Co., Detroit, for carburizing and heat treating roller bearings, cups, cones and rolls. The furnaces were built by the Electric Furnace Co., Salem, Ohio. Greater uniformity of heat treatment is obtained. Close check insures proper control during carburizing. VSP(17)

Vitreous Enameling of Stove Parts. E. F. BERRY. *Metal Cleaning & Finishing*, Vol. 2, Apr. 1930, pages 341–344.
Describes pickling, sand-blasting, and enameling procedure and the electric enameling furnace of the Mansfield Vitreous Enameling Co., Mansfield, Ohio. MS(17)

MACHINERY & SUPPLIES (18)

Rubber Coated Metal Useful in Plating Equipment. GEORGE S. HERRICK. *Iron Age*, Vol. 126, Sept. 4, 1930, pages 618–619.
A German process is employed whereby rubber is deposited on intricate metal articles electrolytically. The rubber provides a perfect insulation and prevents large loss of current in bath. Large tanks are coated by hand. Rubber coating on tanks has an adherence of about 300 lbs./in.^{2} and can withstand a temperature up to 212° F. VSP(18)

Trends in the Design of Forge Equipment. MACDONALD S. REED (Erie Foundry Co.). *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 51–52.
Reviews improvements in hammer design. MS(18)

BIBLIOGRAPHIES (19)

Literature on the Use of X-Ray. Pt. I–II. VICTOR S. POLANSKY. *Heat Treating & Forging*, Vol. 16, July 1930, pages 876–880; Aug. 1930, pages 1011–1014.
Bibliography on X-ray examination of ferrous metals and alloys confined to the literature available in the Technology Dept. of the Carnegie Library of Pittsburgh. The material has been brought up to May 1930. Arranged alphabetically by authors, the last entry being H. Lange. MS(19)

MISCELLANEOUS (20)

Modernization of Existing Steel Plants. A. L. REICHERT (Bourne-Fuller Co.). *Rolling Mill Journal*, Vol. 4, April 1930, pages 135–138.
Points out that maintenance costs can be reduced and production increased in existing steel plants by the application of such improvements as twin motor roll drives, "one way fired" soaking-pits, electrically driven soaking-pit covers, electric furnaces, anti-friction bearings, and oil-electric locomotives for yard duty. MS(20)

Study of Methods for Determining Moisture in Sand. S. H. GRAF & R. H. JOHNSON. *Proceedings American Society for Testing Materials*, Vol. 30, Part 2, 1930, pages 578–590.
This deals with the determination of moisture in sand for concrete, and does not state whether the conclusions apply to molding sands. Thirteen methods were examined. To determine total moisture, three methods, (A) oven drying, (B) distillation, (C) alcohol, are graded in the following order: For accuracy, A, B, C; for simplicity, B, A, C; for requiring minimum apparatus, C, A, B. Electrical resistance methods are inaccurate. (20)

Handling of Hot Metal. WALTER DE FRIES (William B. Pollock Co.). *Rolling Mill Journal*, Vol. 4, June 1930, pages 297–298.
Abstract of a paper read before the Association of Iron & Steel Electrical Engineers, June 16–20, 1930. MS(20)

Abrupt Deformation. (Zur Frage der sprungartigen Deformation.) N. DAWIDENKOW. *Zeitschrift für Physik*, Vol. 61, Mar. 21, 1930, pages 46–53.
A report from the Leningrad Laboratory of Engineering Physics. Suggests that the phenomena observed by Classen-Nekludowa are due, possibly, to sudden decrease in resistance to deformation after the beginning of the flow of material and to reduction in strength on account of recrystallization. (20)

Behavior of Thorium Oxide in Annealed Tungsten Wires. (Zum Verhalten des Thoroxyds in Wolframglühdrähten.) W. G. BURGERS & J. A. M. VAN LIEMPT. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 193, Oct. 10, 1930, pages 144–160.
Roentgenographic investigations shows that in unannealed drawn W wire containing ThO_2 and of poly-crystalline structure the oxide of Th is present as such. In single crystal wire the ThO_2 crystallite shows no preferential orientation. By annealing the poly-crystalline at high temperatures (above 2500° abs.) part of the ThO_2 is reduced to metallic Th. At these temperatures, there is also the possibility of incomplete reduction of ThO_2 with the formation of oxides intermediate between the metal and ThO_2. The existence of a face centered lattice with a parameter between those of ThO_2 and Th was observed, and it was also found that a lattice with varying values of parameter could be obtained by annealing superficially oxidized Th wire in vacuo for different time intervals. Accurate determinations of the lattice constructions of ThO_2 and Th were made, the following values being obtained for a: ThO_2, highly ignited and prepared from the nitrate -5.585 ± 0.001 A. U.; Th prepared by reduction of chloride with Na -5.074 ± 0.002 A. U.; Th metal prepared by thermal decomposition of the iodide -5.081 ± 0.002 A. U. (20)

Inorganic Lubricants. I. Amalgams. WILLIS A. BOUGHTON. *Journal American Chemical Society*, Vol. 52, June 1930, pages 2421–2422.
A note describing the use of amalgams as a lubricant for glass joints. The surface is silvered and then treated with Hg or with a complex amalgam. Such amalgamated surfaces are not permanent. MEH(20)

Problems of Lubrication in the Steel Plant. GEORGE M. COLBURN (Carnegie Steel Co.). *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 454–456.
Outlines essential features of good lubrication of steel-mill equipment from a practical point of view. MS(20)

Manufacture of Seamless Steel Tubing. J. W. URQUHART. *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 627–630.
Seamless tubing is finding many uses in Great Britain and the production exceeds that of many other countries. Trend is toward the use of high C and alloy steels as well as low C steel. Describes processes involved in the manufacture of tubes. MS(20)

A Rapid Method for Sorting Aluminium Scrap. ROBERT J. ANDERSON. *Metal Industry*, London, Vol. 37, July 11, 1930, pages 27–29.
Describes a device to facilitate hand sorting of mixed scrap containing pure Al and various grades of alloy scrap. Method of sorting is based on the measurement of the thermal electromotive force of a couple, one element of which is Al and the other an Al alloy. Equipment was designed especially for production sorting in secondary Al work. Particularly adaptable in sorting and testing, and to distinguish so-called 2S and 3S sheets. VSP(20)

Diversification Aids Malleable. E. K. SMITH & F. B. RIGGAN. *Iron Age*, Vol. 125, July 19, 1930, pages 1825–1827.
In non-ferrous field, brass and lighter alloys are making great progress. Die castings are becoming more popular. Steel castings with tensile strength from 50,000 lbs./in.^{2} to beyond 100,000 can be had. Gray iron castings with resistance to corrosion, wear, and pressure are obtainable. Boyden, Moldenke, Schwartz, and Bean are responsible for progress made in malleable. Possibilities for further research. Greater technical flexibility is needed by industry at large. VSP(20)

Briquetting Cast Iron Scrap for Melting. L. M. JORDAN. *Heat Treating & Forging*, Vol. 16, April 1930, pages 470, 483.
Dodge Brothers reclaim cast-iron boring and turnings for use in the cupola by compressing the loose chips with hydraulic pressure into briquets. Pressure used is approximately 50,000 lbs./in.^{2} Briquets are $3^1/_2$ in long and 4 in. in diameter and weigh from 8–10 lbs. Average density is about 80% of that of the solid iron from which they were turned. Packard Motor Car Co. has a similar machine but uses air instead of hydraulic pressure. MS(20)

What Does Industry Want in the Training of Metallurgists? STEPHEN L. GOODALE (Univ. of Pittsburgh). *Mining & Metallurgy*, Vol. 11, May 1930, pages 248–249.

Read before committee on engineering education, American Institute of Mining and Metallurgical Engineers, New York, Feb. 1930. College training should cover mathematics, physics, mechanics, electricity, chemistry and physical chemistry. Report of several industrial representatives at the University of Pittsburgh was that college students should work in industry at periods during their college course. Education is governed by the general law of demand and supply. Industry asks that students' courses include thorough training in sciences of some cultural study, some business law and finance and all the metallurgy possible. VSP(20)

Electrolytic Iron from Sulphide Ores. T. D. YENSEN (Westinghouse Electric & Mfg. Co.). *Mining & Metallurgy*, Vol. 11, April 1930, pages 212–213.

Discussion of Technical Publication of American Institute of Mining and Metallurgical Engineers, No. 268 by Robert D. Pike, and others. See *Metals & Alloys*, Vol. 1, May 1930, page 527. VSP(20)

Recovery of Fine Gold and Fine Silver from Gold and Silver Scrap. (Gewinnung von Feingold und Feinsilber aus Altgold- und Altsilberlegierungen.) ERNST ROSENBAUM. *Chemiker-Zeitung*, Vol. 54, Sept. 24, 1930, pages 743–744.

Au is mixed with at least 2.5 its weight of Ag, the alloys melted together and poured into water to form small particles. These are boiled from 2 to 5 times in HNO_3, depending on the proportion of Ag, to dissolve the Ag. Au is washed and remelted. Ag is precipitated with HCl and reduced with NaOH and formaldehyde. If the filings contain Pt and Cu, the Ag and Cu are dissolved in HNO_3, filtered off, and the Pt and Au are dissolved in a small quantity of HCl and HNO_3. This solution is evaporated until syrupy, diluted with H_2O and Pt is precipitated by addition of alcohol and NH_4Cl After filtering it is dried, removed from the paper and carefully ignited. Au is precipitated in the filtrate by treatment with SO_2 or $NaHSO_3$. It is filtered, dried and ignited at a low temperature to avoid loss in weight. CEM(20)

FOUNDRY PRACTICE & APPLIANCES (22)

Casting & Cleaning Technique in the Non-Ferrous Foundry (Die Giess- und Putztechnik in der Metallgiesserei). E. BECKER. No. 13 of H. Hermanns' Series on Works' Practice of Iron, Steel and Non-Ferrous Foundries. Wilhelm Knapp, Halle a. d. Saale, 1931. Paper, $6^1/_4 \times 9^1/_4$ inches, 68 pages. Price 5.50 RM.

Elementary discussion of gating methods, effect of heavy sections ajoining light ones, risers, etc., shanks and ladles. Brief comment on casting rod brass bearings into iron or steel backs, or around iron or steel shafts, babbitting bearings, casting in permanent molds, casting ingots for rolling, making die castings, and centrifugal casting.

Sprue cutters, cutoff saws, bandsaws, tumbling barrels, grinding wheels, sand blasts, pickling methods and filling defects by welding or metal spraying are all discussed.

The discussion on all topics is decidedly brief. The pamphlet might serve as an introduction to the subjects in a high school manual training course.—H. W. Gillett (22)-B-

Magnesium Alloy Castings. E. PLAYER. *Metallurgia*, Vol. 3, Dec. 1930, pages 46, 52.

Elektron (3% Zn, 4% Al, 0.35 Mn, balance Mg) has a specific gravity of 1.82 and a tensile strength of 9–11 tons/in.^{2} A special flux, with a $MgCl_2$ base is recommended for melting. In making sand castings, the Mg reacts with the moisture in the molds even in dry-sand molds. This difficulty can be overcome by means of a patented process in which S and boric acid are mixed with the sand. The metal causes the S to volatilize and protect the mold. Molding practice is in general similar to practice with Al. JLG(22)

Overcoming Alloy Ingot Troubles in the Brass Foundry. WILLIAM E. PAULSON. *Metal Industry*, N. Y., Vol. 28, July 1930, page 336.

From a paper read at the Cleveland meeting of the American Foundrymen's Association, May 12–16, 1930. A purely non-technical discussion of the difficulties experienced in producing non-ferrous castings using alloy ingots. See also *Metals & Alloys*, Vol. 1, Sept. 1930, page 743. VSP(22)

Oil-Sand Cores for Non-Ferrous Castings. N. F. BUDGEN. *Metal Industry*, N. Y., Vol. 28, Aug. 1930, pages 370–371; Sept. 1930, pages 417–419.

Oil sand cores must be waterproof, must have strong green bond, sand grains must be readily wetted by core oil, core must be exceptionally strong and give off very little gas. Advantages and disadvantages of oil-sand cores. Materials and mixtures employed. Prevention of objectionable odors from cores or oil-sand molds is accomplished by baking at suitable temperature, about 250° C. Mortar mill method of mixing oil-sand is preferred. Factors affecting properties of finished cores are time of baking, temperature and atmospheric conditions in the oven, drying stove construction, and moisture absorption after drying. Gives tables showing average transverse strength of cores before and after placing in green sand molds. The use of old oil-sand cores is not generally regarded as very satisfactory. VSP(22)

Aluminum Pan Needs Many Runners. JOSEPH MCGINNIS. *Foundry*, Vol. 58, May 15, 1930, page 60.

Describes method of casting Al vacuum pan 8 ft. 4 in. wide, 12 ft. 6 in. long and $^1/_4$ in. thick. The greatest problem is to keep the castings from cracking. VSP(22)

American Brass Foundry Practice. Pt. VII. Laying Out the Patterns. CHARLES VICKERS. *Foundry*, Vol. 58, April 15, 1930, pages 69–71, 83–84.

Poor patterns, or poorly arranged patterns, whether on plate or gate, produce more costly castings than well arranged and well designed patterns. Gating of small castings vary greatly. High leakage loss. In case of heavy valves having flanged ends, it is often necessary to put risers on top of flanges. Leakage is caused usually by hard cracks between body and flange. There is considerable difference in alloys used, as some shrink more than others. Fe causes trouble. Pattern-makers should know something about solidification. Ni is added to castings carrying steam pressure. Small amounts of P will control leakage. VSP(22)

The Fundamentals of Brass Foundry Practice. Parts 24 & 25. R. R CLARKE. *Metal Industry*, N. Y., Vol. 28, Aug. 1930, pages 374–375; Oct. 1930, pages 466–467.

On the affinities of some metals for each other depends much of the possibilities of properly alloying metals. Defines and gives examples of mechanical and chemical mixtures. The 3 factors affecting the homogeneity of mechanical union in castings are: specific gravity, melting temperature and mechanical manipulation. In chemical union the metals are combined and maintain that state in remelting and casting without further mechanical aid. In chemical union the properties of the alloys often change radically from those of individual metals. In mechanical union, the properties of the combined metals show an average of their component metals in ratio of the quantities. Part 25 describes basic laws which control the melting and casting of metals and their applications to practical foundry work. Primary effect of Sn and Cu is to harden, to reduce malleability, toughness and ductility and to tend toward brittleness with its advancing ratios. Effect of Zn on Cu is to toughen and cheapen it; the coloring effect on Cu is to "yellow" it. Effect of Pb on Cu is to soften it. It renders mixture anti-frictional. Cu-Sn-Pb alloys are used mainly for bearing purposes. VSP(22)

FURNACES & FUELS (23)

The Heating of Mixers with Blast Furnace Gas. (Ueber die Mischerbeheizung mit Hochofengas.) K. D'HUART. *Stahl und Eisen*, Vol. 50, May 1, 1930, pages 585–588.

The paper describes the various types of heating mixers with blast furnace gas. A new method of heating mixers uses 2 regenerator chambers for heating up the blast furnace gas. This new heating method requires a minimum of space, is simple in construction and has low first cost. GN(23)

Annealing Pressed Steel Hubs. W. M. HEPBURN. *Fuels & Furnaces*, Vol. 8, March 1930, pages 363–364.

At the plant of the Wire Wheel Corporation of America, parts for wire wheels are annealed at 1400° F. in a continuous, counter-flow, pusher type, gas-fired furnace. It is $43^1/_2$ ft. long, $8^1/_2$ ft. wide, and 3 ft. high. Hot zone is 20 ft. long and the heat interchange zones are $11^1/_2$ ft. long. MS(23)

Regenerative-Gas Constant Current Furnaces with Two Chambers. (Zweikammer-Regenerativgas-Gleichstromöfen.) H. FEY. *Stahl und Eisen*, Vol. 50, Feb. 20, 1930, pages 223–229.

A new type of regenerative continuous furnace for heating billets is illustrated and described, after reviewing the development of the furnace type with return flame. In the new furnace, the air current coming from one of the 2 chambers is divided; one part enters the furnace direct, passing through the furnace in one direction, the other part of the air is used for the combustion of cold gas entering the flue direct, in front of the regenerative chambers. The resulting flame heats the regenerative chambers direct. 3 different types of this new furnace are described. The heat efficiency of the chambers amounts to 85%. The furnace produces over the whole length uniformly heated billets. GN(23)

Appliances for Heating Wheel Tires. (Vorrichtungen zum Anwärmen von Radreifen.) H. FEY. *Stahl und Eisen*, Vol. 50, Jan. 30, 1930, pages 131–133.

A new heating device for wheel tires built by the Lindemann Company at Düsseldorf, Germany, is illustrated and described. This new furnace, provided with burners in a segmental arrangement, is distinguished by its simplicity and high output. The gas consumption amounts to 3 m.^{3} of gas for every m. in diameter of the tire, the heating time to 12–15 min. Since the segmental burners can be adjusted on the ground plate, there are no restrictions as to the size of the tires to be heated. GN(23)

High-Frequency Steel Furnaces. D. F. CAMPBELL. *Heat Treating & Forging*, Vol. 16, Oct. 1930, pages 1273–1276; *Engineer*, Vol. 150, Oct. 3, 1930, page 362.

An abstract of a paper read before the Iron and Steel Institute, Prague, Sept. 16, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 16. LFM(23)

The Heating Up of Open-Hearth Furnaces and Casting Ladles. (Das Anheizen von Siemens-Martin-Oefen und Giesspfannen.) G. BULLE. *Stahl und Eisen*, Vol. 50, Feb. 13, 1930, pages 193–205.

Report 180 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The paper gives information on methods of heating up open-hearth furnaces, ladles and stoppers as collected by a questionnaire issued to all German steel mills. The methods of heating up open-hearth furnaces are mostly rather rough; more modern methods are used in heating up ladles and stoppers. In general, the heat required to heat up a newly lined open hearth furnace varies, according to size, from 200 to 1000 $\times$ 10^6 kg.-cal; the heat for heating up ladles varies from 1 to 10 $\times$ 10^6 kg.-cal.; for stoppers from 50,000 to 100,000 kg.-cal. These data, however, do not seem to be very accurate since the heating up is, in many cases, not very carefully done. No doubt improvements are possible in many cases. GN(23)

Testing and Rating Fuel Fired Industrial Furnaces. Parts XIV–XVI. W. C. BUELL, JR. *Fuels & Furnaces*, Vol. 8, April 1930, pages 517–518; May 1930, pages 659–662; June 1930, pages 809–810.

Discusses measurement of the heat lost in furnace cooling water. Presents curves showing the thermal content of commercial Fe or steel, and pure Al, Cu, and Zn at various temperatures, and Oberhoffer's results for pure Fe. Curves are also shown for the heating time of steel 2 in. in cross-section to various final temperatures. The heating time for Fe is about 36% longer than for steel. The heat of the mass is taken as the mean of the outer and the inner (estimated) temperatures. Gives some general comments on measuring and recording temperature, but does not go into details regarding instruments. Illustrates test data sheets. MS(23)

High-Speed Steel Treated in a Special Electric Furnace. E. N. BROOKINGS (Jones & Lawson Machine Co.). *Iron Age*, Vol. 126, Nov. 6, 1930, pages 1295–1298, 1360.

Gives details of construction of the electric furnace used by Jones & Lawson Machine Co. VSP(23)

Factors Governing Fuel Efficiency of Enameling Furnaces. VICTOR J. AZBE. *Fuels & Furnaces*, Vol. 8, Feb. 1930, pages 207–210, 219–220.

Discussion of various factors entering into design, and operation. Excess air and steam should be particularly avoided. Operation should be with as high furnace and as low muffle temperatures as possible. Muffles should be open if possible. Muffle material should have high heat transfer. Furnace should be operated with minimum of draft. Gas flow must be easily controlled and muffles heat uniformly. MS(23)

A Valve Operated Coreless Induction Furnace for High Temperature Research. FRANK ADCOCK. *Transactions Faraday Society*, Vol. 26, Sept. 1930, pages 544–560.

A very complete description, accompanied by numerous diagrams (6) and pictures (3) of a valve operated induction furnace the power supply for which is derived from a transformer converting three-phase current at 3000 v. to single-phase current at 220 v. The efficiency of conversion of alternating into oscillatory energy is discussed, as are also details of technique, as, e. g., difficulties: (1) with the fusion of magnetic materials; (2) due to glow discharges; (3) due to the distillation of metals during melting; and (4) with charges of small pieces and formation of "bridges." Examples of the application of the furnace to high temperature investigations are given. The article is accompanied by 15 illustrations and 1 table. OWE(23)

Open-Hearth Furnace of the Laclede Steel Co. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 971–973.

Describes a 100-ton, oil-fired, automatically controlled furnace. Both furnace and regenerator walls are encased in steel plates to prevent infiltration of air. Air enters regenerators at the side and bottom. Furnace roof is straight. Furnace is charged with cold metal which is melted with an expenditure of about 3,400,000 B. t. u. Yield averages 93%. Due to the melting condition, the charge contains 20% less pig-iron, than is customary. Melting rate will average 10 tons/hr. An average of 27 gallon of 8°–12° Bé oil is burned for each ton of ingots produced. MS(23)

Design and Operation, Gas-Fired Furnaces. C. M. WALTER. *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 240–242.

Paper read before a joint meeting of the Birmingham Section and the Chemical Engineering group of the Society of Chemical Industry, and published in *Chemistry & Industry*, Vol. 48, Oct. 4, 1929, pages 954–961. MS(23)

Gas vs. Electricity for Industrial Heating. *Iron & Coal Trades Review*, Vol. 121, July 4, 1930, page 3.

Abstract of paper by Sir Robert Hadfield and R. J. Sarjant on "Relative Places of Gas and Electricity in Industrial heating," presented before the Second World Power Conference at Berlin. Use depends largely on availability and economic value. Coke oven gas and producer gas are discussed. The later is better suited for regular loads. Gas furnaces, in general, are cheaper in fuel cost but electricity gives higher thermal efficiency. Operation costs generally favor the electric furnace. Gas furnaces are more flexible. For short-cycle or intermittent operations in batch type furnaces, gas is more economical; for long soaking treatment under either batch or continuous conditions, electric furnaces are more suitable. Electric furnaces permit accurate and automatic control. RHP(23)

Use of Blast-Furnace and Coke-Oven Gas in German Iron and Steel Works. *Iron & Coal Trades Review*, Vol. 121; Aug. 15, 1930, pages 220–221; Aug. 22, 1930, pages 256–257.

Abridged from *Stahl und Eisen*. RHP(23)

Heat Transfer in Regenerative Systems. George V. Slottman (Massachusetts Institute of Technology). *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 449–452; April 1930, pages 624–626; Sept. 1930, pages 1469–1470.

Develops simplified formulae for the approximate design of open-hearth furnace regenerators. Shows that rate of heat transfer is determined by the gas velocity in the flues. With a given flue size, the preheat is determined by the height of the regenerator, the cross-sectional area of the checker having little influence, except in determining pressure drop. Preheat temperature is governed by the height of the regenerator, the size of flue and the ratio of volume of waste gas to volume of air. Special brick shapes increase the rate of heat transfer, the heating surface, or provide against plugging. Average brick temperature varies with the inlet gas temperature, and the ratio of the volume of waste gas to the volume of air. An optimum time of cycle exists for each regenerator, which must be determined experimentally. Applies the formulae developed to practical design of regenerators. MS(23)

Recuperators for Super-Temperatures. B. W. Stromberg (Carborundum Company). *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 482–483.

Refractory rods or "corebusters" are placed along the axis of the tubes of Si-C tube recuperators. The rods are supported from the bottom of the tubes by means of a few legs. Their use results in a substantial increase in the inside convection area of the tubes and in an increase in the efficiency of the rate of heat transfer. Several tests indicated that the increase in heat recovered with "corebusters" amounts to about 45%. MS(23)

Automatic Furnace Simplifies Annealing. W. M. Hepburn (Surface Combustion Co.). *Heat Treating & Forging*, Vol. 16, March 1930, pages 374–375, 382.

Mullins Mfg. Co., Salem, Ohio, has installed a gas-fired counterflow, conveyor-type oven, 53 ft. long for annealing stampings. Furnace is divided into preheating, hot, and cooling zones. The hot zone is 17 ft. long and temperature is maintained at 1650° F. Heat cycle is 4 min. in preheating zone, 6 min. in the hot zone, and 4 min. in the cooling zone. MS(23)

Refractory Torches for Local Heating. F. E. Harris. *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 97–99.

Describes the design of gas-air torches for local heating of metal parts, and discusses the underlying principles. General design consists of a mixture nozzle and a refractory-lines combustion tip. The latter has flaring walls. Describes application to annealing portions of a radiator shell and to local annealing of a gear blank. Local temperatures of 1500° F., in 6–8 sec. are easily attained. MS(23)

Butane Burned in Heat Treating Furnace. Charles Longenecker. *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 100–102.

Chrysler plant in Detroit uses C_4H_{10} as fuel for hardening and drawing furnaces. Axle shafts are heated to 1550° F. in the former and to 880° F. in the latter. Tabulates properties of the gas, and describes method of unloading the liquified product from tank cars, means of storage, and distribution of fuel in the plant. Some of the advantages of using C_4H_{10} are constant heat value and pressure; accurate temperature control; low percentages of rejections; great hardness; easy and economical distribution; scaling of steel is negligible; and safety is promoted. MS(23)

Heat Treatment of Ball Bearing Races. W. B. Haag (Marlin-Rockwell Corp.) & Wirt S. Scott (Westinghouse Electric & Mfg. Co.). *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 64–69.

The Marlin-Rockwell Corp. replaced oil-fired salt-bath hardening furnaces and gas-fired oil-tempering baths with 3 new oil-fired, semi-muffle, underfired box type furnaces, one rotary-hearth electric furnace, and one electrically-heated oil-tempering bath. The electric furnace accomplished a saving in labor, better quality, better working conditions, increased production, saving in ventilating equipment, saving in maintenance, and improvement in shop appearance. The estimated total net savings of the rotary-hearth electric furnace over the oil-fired salt-bath furnaces amounted to $2513.00 per month on a production basis of 150,000 lbs. per month. The savings over the hearth-type oil-fired furnaces amounted to $770.00 per month. Cost and savings are tabulated. MS(23)

Heating by Electricity Found Profitable. Francis W. Rowe. *Heat Treating & Forging*, Vol. 16, May 1930, pages 643–648.

Works with which author is associated manufacture gears and gear units. Present furnace equipment consists of three 25 kw. reheating furnaces and a 40 kw., a 200 kw., and two 100 kw. carburizing furnaces. These replaced coke-fired muffle-type carburizing furnaces, semi-muffle type carburizing furnaces with coke-fired producers built in, and reheating furnaces fired by town gas and producer gas. Presents tables giving cost of energy for each of the furnaces. In no case is the cost for fuel alone higher with the electric furnaces than was the case with the old furnaces. Use of electric furnaces has resulted in saving in labor, improved working conditions, and improved quality of output. MS(23)

New Type of Pair Heating Furnace. T. J. Ess (Central Alloy Steel Corp.). *Heat Treating & Forging*, Vol. 16, May 1930, pages 648–650; *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1137–1138, 1142.

Described the McCann conveyor-hearth furnace for pair heating. It is encased in a shell of structural plates and shapes with all openings amply protected with cast-iron plates and panels. Conveyor consists of a heavy steel frame extending under the charging platform and furnace, carried on a series of rollers. Cr-Ni alloy posts are mounted on frame bottom, carrying alloy cross rails and conveyor rails inside of the furnace. Rollers are connected through a series of pull-rods and bell-cranks to the duplex drive mounted under the charging platform and consisting of a motor-driven constant-speed driving-shaft, a lifting-shaft, and a traversing shaft, all interconnected with specially designed gearing. Furnace is approximately 25 ft. long × 6 ft. 9 in. wide, and is well insulated. Burner equipment consists of 14 McKee high-pressure gas-injector burners, using natural gas at pressures up to 25 lbs./in.^{2} Furnace is divided into 2 zones, temperature of each being independently controlled. Including gas used for warming up furnace after week-end shutdown, average gas consumption is 1107 cu. ft./net ton of metal charged. MS(23)

Scholes-Incandescent Patent Plate-Heating Furnace at Consett Works Durham. *Iron & Coal Trades Review*, Vol. 121, July 4, 1930, pages 1–2.

Describes a furnace designed to treat plate uniformly throughout at the same time maintaining straightness. Main points of construction and operation are: (1) load in charging or discharging is not carried on the furnace hearth; (2) furnace roller gear remains in the hot zone of furnace for a minimum of time; (3) material is not marked or affected by skid bars; (4) burners are arranged alternately on either side of furnace to give uniform heating; (5) gas and air supplied under pressure; (6) preheating is done by passing both gas and air through mild steel tubes under the furnace hearth; (7) flue arrangement avoids explosions; (8) furnace is easily lit up. Gives power consumed, analysis of gas and temperature. RHP(23)

Normalizing Furnace for Sheet Steel. J. R. Miller. *Heat Treating & Forging*, Vol. 16, April 1930, pages 507–508.

Central Alloy Steel Corp. has installed in its Canton, Ohio, plant a natural-gas-fired walking-beam normalizing furnace. Furnace proper is 100 ft. long and is divided into a 10-ft. preheat zone, a 30-ft. first heating zone, a 20-ft. first cooling zone, a 30-ft. second heating zone, and a 10-ft. final cooling zone. It is wide enough to accommodate sheets up to 108 in. wide. It will treat 8 tons of sheets per hr. Gas consumption is about 1300 cu. ft. of natural gas per gross ton of material heated. Burners are arranged for combined over- and under-firing. Furnace is designed to work satisfactorily at any temperature up to a maximum of 1850° F. Speed of stock through furnace can be regulated from $2^1/_2$–10 ft./min. depending upon the gage of the sheet and other variables. MS(23)

Electric Heat and Heat Treating Alloy Steel. Thomas W. Hardy (Dept. of Mines, Canada). *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 53–58.

Electric heating furnaces have certain advantages which more than outweigh the higher initial cost as compared with that of fuel-fired furnaces, and the higher cost of electricity over fuel on a strictly B. t. u. basis. These are lower labor and maintenance costs, more efficient utilization of energy, and the ability to positively reproduce established time-temperature cycles. Car-bottom type of furnace is most satisfactory for miscellaneous short cycle annealing. Pit type is most suitable for annealing of such refractory steels has high C-high Cr steel, requiring time cycles as long as 80 hrs. or more. Continuous furnaces are best for normalizing. A double-end type has been designed for the heat treatment of bars in mill lengths. For the annealing of coiled rods or wire, a circular pit furnace has been found to be very satisfactory. Describes some installations of these types of electric furnaces. MS(23)

Electrical Equipment for Heat Treating. C. L. Fisher (Westinghouse Electric & Mfg. Co.). *Heat Treating & Forging*, Vol. 16, June 1930, pages 775–777.

Illustrated description of the furnaces used by the Westinghouse Electric & Manufacturing Company in the heat treatment of tools. All heat treating equipment is electrically controlled. All oil, Pb, salt and salt tempering units, and some oven-type furnaces are electrically heated. Some of the oven-type furnaces are gas-heated. Gas at 15 lbs. pressure is used, as it can be more readily controlled electrically than on air blast used with gas at ordinary pressure. MS(23)

Economical Operation Obtained with New Commercial Gas. George J. Hales (General Electric Co.). *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1117–1118.

General Electric Co. has developed a gas, Electrolene, for use in many processes where pure H is not required. It is the product derived from dissociating a hydrocarbon gas, usually with the addition of steam. It contains approximately 75% H, 20% CO, and small quantities of other gases, N being the most prominent. Input gas can be any gas containing sufficient hydrocarbons to make the process economical. Producers are comparatively inexpensive to install. The new gas is used as a non-oxidizing atmosphere in furnaces for Cu brazing and as neutral atmosphere for annealing. By varying the CH_4 content, a gas neutral to any C steels can be obtained which will prevent decarburization of the metal. MS(23)

Automatic Reversing Open Hearth Furnaces. Bradley. *Fuels & Furnaces*, Vol. 8, July 1930, pages 979–980, 986.

From paper read before the Association of Iron & Steel Electrical Engineers, June 16–20, 1930. MS(23)

Heat Requirements for Core Baking Ovens. H. L. Campbell (University of Michigan). *Fuels & Furnaces*, Vol. 8, July 1930, pages 955–956.

Most favorable temperature for baking cores containing only water-soluble binders and those bonded with pitch and rosin is 350° F. Oil binders require an oven atmosphere containing fresh air. A minimum volume of 1000 in.^{3} of air is necessary to develop maximum strength in one lb. cores containing raw linseed oil in the proportion of 2% of the volume of the core sand. Baking for 90 min. at 425° F. produces maximum strength in 1 in. thick oil-sand cores. Best temperature for cores containing mixtures of water-soluble binders and oil is 400° F. Both time and temperature must be controlled accurately to produce maximum strength. Industrial gas is especially suited for baking cores. MS(23)

High Frequency Induction Furnaces Used in Melting Tool Steels. *Fuels & Furnaces*, Vol. 8, July 1930, pages 951–952.

Firth-Sterling Steel Co., McKeesport, Pa., has 2 Ajax-Northrup furnaces of 500 and 1000 lbs. capacity, respectively. Melting is done in MgO crucibles placed inside a lining composed of a dry powdered refractory such as chrome ore or electrically fused MgO. Cu cooling coil acts as the primary, the secondary being the melt itself. Single phase current at 800 volts and a frequency of 960 cycles is used. The furnace is rated at 150 kw. and requires about 50 min. to melt a 500 lbs. charge. MS(23)

Brass Strip Annealed in Oil Fires Furnace. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1065–1066.

Dallas Brass and Copper Co., Chicago, has installed a side-fired furnace with 12 oil burners and automatic temperature control. Slabs of rolled metal are carried through the furnace in alloy pans on roller conveyors. Stock withdrawn from the furnace is quenched by cold water spray. Operating temperature of the furnace is 1150°–1450° F., depending on the gage and composition of the metal. One pan enters the furnace about every 2 or $2^1/_2$ hrs. MS(23)

High Frequency Electric Furnaces and Their Practical Characteristics. (Les four electriques a haute frequence et leur characteristiques pratiques.) *Journal du Four Electrique*, Vol. 39, Sept. 1930, pages 336–339.

Brief description of better known installation of Ajax-Northrup high frequency furnaces in the United States. JDG(23)

The Utilization of Town's Gas as a Fuel in Heat Treatment Furnaces. C. M. Walter. *Metal Industry*, London, Vol. 36, June 20, 1930, pages 651–654; June 27, 1930, pages 677–682; *Journal Institute of Fuel*, Vol. 3, July 1930, pages 408–427.

Paper read before Institute of Fuels, May 14, 1930. Deals with a special application of town's gas as a fuel to a particular industrial operation and the various stages of development in the design of inflame type gas-furnace. Low calorific value gas is often associated with high calorific intensity, due to high % of CO. Gives operating costs in terms of efficiency. Development in the design of gas-heated oven type furnaces. Specifications for recuperator oven furnace is given. Includes results of furnace tests and numerous tables and diagrams. VSP(23)

REFRACTORIES & FURNACE MATERIALS (24)

Bottoms in Forging Furnaces. *Heat Treating & Forging*, Vol. 16, May 1930, page 658. Condensed in *Fuels & Furnaces*, Vol. 8, June 1930, page 858.

Abstract of survey made by A. C. Nielsen Co., Rockford Drop Forge Co. in replacing the ordinary fire-brick construction formerly used in their forging furnaces with monolithic bottoms made of plastic chrome ore. A complete elimination of slagging and a saving of 57% in bottom costs is claimed. MS(24)

Refractories and Their Applications. MARTIN J. CONWAY (Lukens Steel Co.). *Heat Treating & Forging*, Vol. 16, June 1930, pages 732–734; *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 1001–1003.

In practice, term "refractory" means not only resistance to high temperatures, but includes also resistance to disintegration by other causes, such as abrasive action of the contents of the furnaces, dust in flue gases, corrosion by gases or other substances, and sudden changes in temperature. Discusses permanent expansion of fire-brick. Greatest contribution to furnace design and refractory life in recent years has been the substitution of suspended refractory for the conventional sprung arch and the adaptation of this type of construction to the side walls as well as the roofs and arches of all types of industrial and boiler furnaces. Discusses disadvantages of the sprung arch and advantages of the flat arch. MS(24)

Interlocking Suspended Furnace Arch. W. J. SHANE. *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 1013–1014.

Describes arch patented by L. S. Longenecker. Makes use of an interlocking title, which has on one of its faces an inverted V-shaped tongue about 3/8 in. thick, and on the opposite face a similarly shaped groove. Tongue and groove furnish a positive interlock which will hold any broken inner tile ends from dropping out. Each tile is equipped with a modified U-casting hanger having a T-end which fits into the T-slot of the tile, located directly above the tonue. The short leg of the U-casting makes contact on the groove side. The hanger serves as a handle to lift the tile. The tiles are suspended directly from the lower flange of an I-beam in bundles of 12, by means of the special "Thumb and Finger" type beam casting. MS(24)

Furnace Insulation in the Steel Mill. E. A. PHOENIX (Johns-Manville Corp.). *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 1005–1010.

Insulating materials for high temperatures must have low thermal conductivity and high degree of refractoriness. Diatomaceous silica forms the base for almost every high temperature insulating material in use today, because it possesses these properties. It is produced in a wide variety of forms. Illustrates and describes methods of insulating hot-blast stoves, blast-furnace stacks, open-hearth plant, soaking-pits, and heating, annealing, and heat-treating furnace. Includes curves of comparative heat losses. MS(24)

GASES IN METALS (25)

Experiments on the Influence of Gases on the Soundness of Copper Ingots. N. P. ALLEN. *Journal of the Institute of Metals*, Vol. 43, 1930, pages 81–124, 142–162.

Includes discussion. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. (25)

Gases in Copper and Their Removal. W. E. PRYTHERCH. *Journal of the Institute of Metals*, Vol. 43, 1930, pages 73–80; 142–162.

Includes discussion. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 745. (25)

Gas Removal and Grain Refinement of Aluminium Alloys. W. ROSENHAIN, J. D. GROGAN & T. H. SCHOFIELD. *Engineer*, Vol. 150, Sept. 19, 1930, pages 317–318.

Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. LFM(25)

EFFECT OF ELEMENTS ON METALS & ALLOYS (27)

Arsenic in Soft Steel. (Arsen im Flusstahl.) O. BAUER. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 58–66; *Mitteilungen Verein Grosskesselbesitzer*, No. 23, 1929, pages 3–10.

English, American and German sheet analyzed at the Staatlichen Materialprüfungsamt showed from 0.02–0.095% As, mostly between 0.035% and 0.05% As. No sample tested was arsenic-free. Soft steel plates of 0.06–0.09% C, 0.36–0.41% Mn, 0.03–0.11% S, 0.01–0.09% P and 0.04–0.11% As, with only traces of Si, Cu, Cr, Ni and Co, were specially made up and tested. The samples were in 4 groups: (a) 0.03–0.04% S, 0.015% P with 0.05–0.09% As; (b) 0.11–0.14% S, 0.015–0.025% P with 0.04–0.11% As; (c) 0.10% S, 0.03–0.08% P with 0.04 to 0.075% As; and (d) 0.04–0.05% S, 0.085–0.095% P, with 0.045–0.11% As. There were 3 steels in each group. Macroetching with copper ammonium chloride for segregation showed this to be due to P, not to As. Microscopic examination showed no change in structure ascribable to As. Critical point determinations showed no effect due to As. Static tensile tests showed the whole series to vary only from 34,000 to 40,500 lbs./in.^{2} yield point, 51,000 to 58,000 lbs./in.^{2} tensile strength, 23–32% elongation in 8", 56–68% reduction of area, whether tested longitudinally or transversely. Some slight effect of phosphorus was discernable, but no effect of arsenic could be traced. Charpy impact tests (drilled notch) in the as rolled and annealed conditions on longitudinal and transverse bars ranged from 14.5 to 5 mkg./cm.^{2} The transverse bars gave lower values than the longitudinal in the case of the steels higher in sulphur. High phosphorus steels gave low impact tests. After giving due regard to the effect of P and S in lowering the impact resistance, there was some evidence that their deleterious effect is somewhat increased by the presence of As. Impact tests were also made at −5°, 20°, 50°, 100°, 200°, 250°, 300°, 400°, and 500° C., on transverse specimens of the 2 steels of each of the 4 groups highest and lowest in As. All fell off in impact strength above 250° C., and all showed an appreciable decrease at −5° C. as compared with room temperature. The general trend indicates again that As has an embrittling influence. The effect of P was not so noticeable at the higher temperatures, while that of S was more marked than at room temperature. Transverse impact specimens that had been cold-worked by compression over the volume in which the notch was to be cut, and tested as compressed or after tempering 2 hours at 100° intervals from 100° to 900° C., were all very brittle (impact resistance only 0.7 to 2.1 mkg./cm.^{2}) up to a tempering temperature of 500° C. at which some improvement was shown. On tempering at 600–700° C. the impact values became about the same as for uncompressed annealed specimens. In the worked and tempered series the presence of As again seemed slightly to accentuate the harmful effect of P and S. It is concluded that up to 0.05% As is without material effect on any of the mechanical properties, even on impact, while larger amounts in themselves bring a rather weak harmful effect, less than that of P and S, but intensify the effect of those elements. HWG(27)

The Effect of Phosphorus on the Strength of Admiralty Gun-Metal. H. C. DEWS. *Engineering*, Vol. 130, Sept. 26, 1930, pages 388–389.

Abstract of paper read before the Institute of Metals, Southampton Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930 page 789. LFM(27)

Investigations on the Influence of the Structure and the Chemical Composition of the Physical Properties of Rails. (Beitrag zu den Untersuchungen über den Einfluss des Gefüges und der chemischen Zusammensetzung auf die mechanischen Eigenschaften von Schienen.) J. E. BRAGNIN. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1589–1590.

Abstract of a paper in the Russian magazine, *Ugol i Scheleso*, Vol. 49, 1929, pages 88–122. The physical properties of 300 rails of various open-hearth steel melts were studied, including an examination of the microstructure. From the results, the authors draw the conclusion that the best values of the limit of proportionality and the limit of elasticity are obtained in rails with a C content of 0.40–0.45% and a Mn content between 1.05% and 1.10%. GN(27)

The Influence of a Third Metal on the Constitution of Brass. II. Influence of Nickel. (Der Einfluss von dritten Metallen auf die Konstitution der Messinglegierungen. II. Der Einfluss von Nickel.) O. BAUER & M. HANSEN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 7–25.

See *Metals & Alloys*, Vol. 1, August 1930, page 685. HWG(27)

Heat Treating Alloy Steel Castings. Three Methods Used. Low and High Alloy Steel Castings Have Many Uses. ALBERT RYS. *Iron Age*, Vol. 125, June 19, 1930, pages 1821–1822; Aug. 28, 1930, pages 549, 598.

Abstract translation by J. M. Gaines, Jr., from *Stahl und Eisen*, Vol. 50, Apr. 3, 1930, page 423. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 685. VSP(27)

Hardness of Aluminum Rich Binary Alloys in Relation to the Concentration of Added Metal. (Die Härte aluminiumreicher binärer Legierungen in Abhängigkeit von der Konzentration des Zusatzmetalles.) K. RÖTH. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 191, Aug. 2, 1930, pages 181–193.

The author finds a definite relationship between depth of penetration in Ludwik's cone method for determining hardness and the volume % of the intermetallic compound formed between Al and the added metal. This is given by the expression $h = a + \ln P_v$, where h is depth of penetration, a is the value of h for 1% by volume of the compound Al_mMe_n, and P_v is the % by volume of the compound of the added metal with $Al(Al_mMe_n)$. Data is given for binary alloys of Al with Si, Cu, Ni, Ca, Mg, Mn and Zn, and good agreement between calculated and experimentally determined values of h is obtained. (27)

Nickel-Molybdenum Steel Castings Strong at High Temperatures. LIESTMANN & SALZMANN. *Iron Age*, Vol. 126, Aug. 21, 1930, page 484.

Abstract translation of a report in *Stahl und Eisen*, No. 50, 1930. Gives a report of a systematic study of a series of cast alloys containing various small percentages of nickel and molybdenum. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 685. VSP(27)

Manganese in Simple Steels. HENRY D. HIBBARD. *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 51–54; Feb. 1930, pages 217–219; March 1930, pages 391–393; April 1930, pages 541–542, 548; May 1930, pages 673–674; June 1930, pages 815–816.

Gives first a short history of the use of Mn in steel. Discusses Mn in the open-hearth charge materials, and the part played by it in working the charge; its function in eliminating oxides and regulating the boil of the bath; action of MnO; elimination of S; Mn additions to killed and rimming steels, in the ladle and in the mold; and effect of Mn in the ingot. MS(27)

A Study of Ni-V and Ni-Mo Cast Irons. (Etude sur les fontes au nickel-vanadium et au nickel-molybdene.) JEAN CHALLONSONNET. *Revue de Metallurgie*, Vol. 27, Nov. 1930, pages 573–603.

The influence of addition of Ni, V and combination of the two to carefully prepared synthetic iron (3.7 C, 0.08 Si, P traces) and to several commercial irons showed that addition of 1–2% of Ni had no influence on Curie point of cementite but lowers the point of the beginning of graphitization. It lowers both Ac and Ar points, and decreases the cementite content. 2% Ni was sufficient to cause martensitic transformation in several irons, easily discernible on dilatation curves. Addition of 0.25–0.5 % V lowers Curie point in pure Fe-C alloys to 160° and 130°, respectively, in commercial irons it lowers it to 180° and 130° not being affected by C, Si or Ni. V does not affect transformation points when present alone but counterbalances the influence of Ni when they are found together. It prevents graphitization, entirely in the case of rapid cooling, partially when Ni and Si are present. One % Ni is equivalent in this respect to 0.25% V. Being added simultaneously Ni and V counterbalance each other's effects on graphitization and cementite formation. V prevents the formation of martensite due to high Ni. In casting in stepped molds so that different rates of cooling speed could be observed it was found that V rapidly increases chilling effect while Ni lowers hardness gradient between the steps. Addition of 0.5% V increases the crushing resistance by 40 kg./mm.^{2} while 2% Ni raises it 10 kg./mm.^{2} Simultaneous addition of them gives the increase of 40 kg./mm.^{2} Their influence is greatly reduced by increased Si content. 7 references. JDG(27)

Effect of Small Additions of Copper and Nickel on the Dilation and Grain Growth of Cast Iron. (Der Einfluss kleiner Zusätze von Kupfer und Nickel auf die Wärmeausdehnung und auf das Wachsen des Gusseisens.) O. BAUER & H. SIEGLERSCHMIDT. *Mitteilungen deutscher Materialprüfungsanstalt*, Sonderheft 9, 1929, pages 63–67.

From 20° to 670° the dilation value β is not perceptibly influenced by the additions. After the decomposition of the carbide there is no permanent expansion. Small additions of Cu and Ni apparently retard the decomposition. RR(27)

Molybdenum Improves Gray Iron. J. KENT SMITH. *Foundry*, Vol. 58, June 15, 1930, pages 54–55.

Mo improves strength, density, as evidenced by grain size, absence of blow holes and hard spots, excellent machinability and minimizes foundry difficulties in cast Fe. Addition amounts to about 0.35% Mo or 7 lbs. to a short ton of clean hot cast Fe containing 3 to 3.25% C and 1.9 to 2.1% Si. Mo enters solid solution in carbonless portion of Fe and thus strengthens the Fe directly. Molybdenizing cast Fe is different from molybdenizing steel. If cupola is used as melting agent, Mo must be added in the ladle. Best method of adding Mo is by use of a Mo-Fe alloy. This alloy contains from 60–65% Mo. Tabulates data on Mo additions. VSP(27)

Tests Show Effect of Using Alloy Scrap in Making Pig Iron. E. K. SMITH & H. C. AUFDERHAAR. *Iron Age*, Vol. 126, July 17, 1930, pages 156–158.

Deals with the effects of small amounts of common alloys on characteristics of pig Fe. Describes experiments conducted. From dilatometer curves it can be noted that unalloyed pig Fe shows greatest expansion, Cr pig slight and Ti pig intermediate. From experiments following conclusions were reached: (1) alloy scrap should not be used in making pig Fe for malleable castings; (2) when alloy scrap is used for steel making or foundry pig Fe blast furnace should furnish consumer with approximate alloy contents; (3) effect of small amounts of alloys would be as cleansers and deoxidizers of pig Fe; (4) blast furnace is proper place for miscellaneous scrap, owing to its desulphurization and deoxidation; alloy scrap used in cupola would be undesirable; (5) there is little danger of any detrimental effect on castings, considering small amounts of alloys found in pig Fe. VSP(27)

INSTRUMENTS & CONTROLLERS (28)

The Influence of the Emission Property on the Determination of the Temperature of Liquid Iron. (Einfluss des Emissionsvermögens auf die Temperaturmessung am flüssigen Eisen.) RUDOLF HASE. *Archiv für Eisenhüttenwesen*, Vol. 5, Nov. 1930, pages 261–264; *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, pages 1813–1814.

The paper summarizes the results of comparative temperature measurements taken on liquid cupola Fe with a thermocouple and an optical pyrometer (system Optix), respectively. In addition to these temperature measurements, moving pictures were taken of the sighted surface of the liquid metal. In comparing the true temperatures (thermocouple) with the relative temperatures (optical pyrometer), it is shown that the readings with the optical pyrometer should not be taken in the middle part of the spout of the cupola. The true and relative temperatures were found to be in satisfactory accordance only when the readings are taken when the jet of metal pours into the ladle. In 20 additional laboratory tests, the emission value of oxidized and non-oxidized metal surfaces was determined. In the temperature range from 1250° to 1600° C., the error of temperature of the non-oxidized metal surface continuously increases from 85° to 140° C. The similar curve of the temperature of the oxidized surface has a constant course up to 1400° C. but splits into 2 branches at this temperature. Between 1250° and 1600° C., the emission value of the non-oxidized Fe is on the average 0.44 ± 0.03; of the oxidized Fe, 0.95 ± 0.05. The paper, furthermore, contains temperature correction data of liquid Fe of various compositions. GN(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

Materials at High Temperatures. (Materialen bei hohen Temperaturen.) A. POMP (Kaiser Wilhelm Institut für Eisenforschung). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 80–84. 25 references.

Brief discussion of methods of testing. Alleges that limiting creep stress can be approximated in short-cut tests of the creep rate in the third and sixth hours if the test does not exceed 0.001%. A list of limiting creep stresses is given for 10 plain carbon steels of 0.06–0.29% C and for 4 nickel steels of 0.09–0.12% C with 3.18–4.80% Ni at 300°, 400° and 500° C. Figures given for steel of practically the same composition vary considerably. The figures on 2 steels of 0.06% and 0.07% C. at 400° C. are given as 10,000 and 14,000 lbs./in.², determined by the short-cut method. HWG(29)

Oxidation, Carburization and Graphitization of Iron and Steel. M. L. BECKER. *Fuels & Furnaces*, Vol. 8, July 1930, pages 961–962, 972.

From paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. MS(29)

Permanence of Dimensions under Stress at Elevated Temperatures. W. H. HATFIELD. *Engineer*, Oct. 10, 1930, Vol. 150, pages 408–410; *Engineering*, Vol. 130, Sept. 26, 1930, page 404.

Abstract of paper read before the Iron and Steel Institute, Prague, Sept. 15, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 20. LFM(29)

Strength of Steel at High Temperatures. L. M. JORDAN. *Heat Treating & Forging*, Vol. 16, Feb. 1930, pages 182–184.

Reviews recent investigations, particularly those of the National Physical Laboratory, published in *Engineer*, Vol. 146, pages 707–709; and of C. E. Stromeyer published in his 1929 report to the Manchester Steam Users' Association. MS(29)

LEACHING (30)

Chemistry of Leaching Covellite. JOHN D. SULLIVAN. *United States Bureau of Mines, Technical Paper* No. 487, 1930, 18 pages.

Covellite can be leached with ferric sulphate. The rate of dissolution was virtually the same for — 100 + 200 mesh covellite in solutions containing 1 and 2% of ferric iron; also for — 10 + 28 mesh material in 0.5 to 2% ferric iron solution. The rate was practically independent of acid strength for the first 8 days, when ferric iron concentration remained constant at 1%. Sulphuric acid in the presence of air attacked covellite at ½ the rate of ferric sulphate. Increased temperature markedly increased dissolution rate. Artificial covellite produced by leaching chalcocite dissolved at a much faster rate than natural covellite. AHE(30)

Agglomeration and Leaching of Slimes and Other Finely Divided Ores. JOHN D. SULLIVAN & ALFRED P. TOWNE. *United States Bureau of Mines, Bulletin* 329, 1930, 60 pages.

Cu in concentrator tailings can be recovered by agglomerating the ore and leaching by the open-drainage trickle method. Coarse material must be added to the sand and slime to act as a nucleus upon which the fine material can build. About 10% moisture is necessary. Solutions percolated freely through agglomerated ore containing up to 30% —200 mesh material with 90% extraction of acid solution Cu and 80% of total Cu when the ratio of oxidized to sulphide copper was approximately 1:1. By recirculation, Cu concentration was built up to 61 g./l. Experiments were conducted on all scales up to 12 tons. AHE(30)

REDUCTION METALLURGY (31)

Some Principles of Hot Blast Stove Design. A. J. BOYNTON & S. P. KINNEY (H. A. Brassert & Co.). *Blast Furnace & Steel Plant*, Vol. 18, Feb. 1930, pages 283–288.

Greatest efficiency is obtained where high gas velocities and turbulence of flow promote transfer by convection. Former is attained through use of small checker opening, the latter by disturbing stream line flow. Construction based on theoretical principles would be impractical from the operating point of view, because of lack of strength, inaccessibility to inspection, excessive pressure drop through the system, and the requirement of gas cleaned to engine specifications. Practical requirements of design which provides for thermal efficiency as well as for strength and convenience are: provision of maximum volume of brick within a minimum space, with the brick so arranged as to present the largest possible heating surface and to maintain high and substantially equal velocities of gases throughout all parts of the stove; small cross-section of flues, particularly in the cooler parts of the stove; continuity of checker flues, for convenience in inspection and repair; provision for creating turbulence of gases without excessive pressure drop through the stove; and adequate structural strength. Compares features of the Pfoser-Strack-Stum, Kuehn, and Brassert constructions. The larger the units and the less their number the more effective will be a given amount of heating surface, other things being equal. Theory and experience show that the use of more than two stoves with a single furnace is attended with considerable heat losses as well as unnecessary expenditure for equipment. MS(31)

Making Cobalt in an Electric Furnace. (La fabrication du cobalt au four electrique.) *Journal du Four electrique*, Vol. 39, Aug. 1930, page 288.

Three electric furnaces at Panda (Belgian Congo) melt either ore concentrates containing Fe, Cu and Co or Co rich slag of Cu smelting water jackets. Practically complete recovery of Cu and Co is obtained. The alloy is shipped to Oolen (Belgium) and is separated there. 708 tons Co were produced in 1929. JDG(31)

Interaction of Gases and Ore in the Blast Furnace. WILLIAM A. BONE, L. REEVE & H. L. SAUNDERS. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1089–1090.

From paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. MS(31)

Basic Open-Hearth Slag as a Valuable Blast Furnace Material. J. F. HORAK (Lukens Steel Co.). *Iron Age*, Vol. 126, Oct. 9, 1930, pages 980–981, 1046.

Open-hearth slag is suitable for blast furnace use because of its chemical composition as well as physical properties. Its chemical composition varies broadly, due to composition of pig Fe, scrap used, grade of steel made, etc. Mn recovery from the slag varies from 45% to 75%. Basic open-hearth slag contains about 20% silica, 42% lime, 7½% magnesia and same amount of Mn, 13% Fe and 3% Al_2O_3, for each 100 lbs. of slag. Sequences of good and bad melts indicate relation of pig Fe quality to steel making process. Mn content is important. On account of its P content, amount of basic open-hearth slag which can be charged into blast furnace is limited. Slag resulting from making low C steels are most suitable. VSP(31)

Blast Furnace Charging Installations and Their Influence on Operation. (Les Installations de Chargement de hauts fourneaux et leur influence sur la condutite de la marche.) HUBERT HOFF. Translated by A. Husson. *Revue de Metallurgie*, Vol. 27, Nov. 1930, pages 604–614.

A brief description and analysis of performance of different types of blast furnace charging devices used both in Europe and America. JDG(31)

Contributions to the Chemistry of the Chlorinating Roasting of Copper and Silver Ores. (Beiträge zur Chemie der Chlorierenden Röstung von Kupfer- und Silbererzen.) F. R. HIEMANN. *Metall und Erz*, Vol. 27, Sept. 1930, pages 474–486.

Contains 49 references. A detailed study is described of the individual chemical and thermal reactions taking place including the decomposition of chlorides by oxygen and steam alone, by oxygen and steam in the presence of acid anhydrides, the formation of chlorides by the action of Cl, and by the action of HCl, reactions between salts containing O and chlorides, between chlorides and sulphides or oxides. The effect of composition of the charge, furnace atmosphere, temperature and catalysts on the process of the chlorination of Cu and Ag ores is studied and discussed. CEM(31)

Investigations on the Friability of Coke Products. (Untersuchungen über die Zerreiblichkeit von Verkokungserzeugnissen.) F. HEINRICH & G. SPECKHARDT. *Stahl und Eisen*, Vol. 50, Dec. 11, 1930, pages 1750–1751.

The authors briefly abstract their article on the same subject in *Glückauf*, Vol. 66, 1930, pages 1285–1292. The various methods of determining the friability of coke which have been used and suggested up to the present time have been critically examined. Conclusions are drawn as to the further development of the practice of testing coke. GN(31)

Blast Furnace Construction and Operation. WILLIAM A. HAVEN (Arthur G. McKee & Co.). *Blast Furnace & Steel Plant*, Vol. 16, Jan. 1930, pages 85–89.

Reviews developments during 1929. Trend has been toward larger furnaces. Several with a 25 ft. or more hearth diameter have been constructed and have proved highly satisfactory. They may be depended upon to produce 1000 or more tons daily. Tendency in stove checker construction is toward smaller openings and thinner walls. Much attention has been given to better gas cleaning equipment. First American installation of disintegrator type washers was made during the year. A record production of 42,500,000 tons of pig-iron was accomplished by an average of only 205 furnaces in blast. The trend in operating practices has been toward greater output per stack, use of higher blast temperatures, reduction of dust losses, and more profitable use of blast-furnace gas. MS(31)

Improvement of Existing Blast Furnaces. JAMES P. DOVEL. *Blast Furnace & Steel Plant*, Vol. 18, Aug. 1930, pages 1285–1286, 1296.

Furnace, an illustration of which is shown, has been redesigned with a thinner inwall lining and with inwall cooling plates and metal top. The shell is strengthened by means of H-beams equally spaced around it, supported by the mantle or by suitable brackets on the lower ring and extending to the furnace-top platform. The advantages claimed are increase in volume above the bosh of 27.4%; increase in stock-line with resultant decrease in quantity of flue-dust; a bell ratio to stock-line which will make active the total area of the furnace; greatly increased contact of gases and stock, with increased thermal efficiency, coke/ton of Fe having been decreased 16–22%; and permanent inwall lining with the relining charge eliminated for this section of the furnace. MS(31)

Furnace Operations in the South. JAMES P. DOVEL (Sloss-Sheffield Steel & Iron Co.). *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, page 113.

Outstanding features in blast-furnace practice are the increasing of stock line diameter and inwall cooling. Tonnage has improved in almost direct proportion to the increased volume of stock column, coke consumption/ton of Fe has been reduced, and flue-dust has been decreased. MS(31)

Effect of High-Grade Concentrates in Reverberatory Practice at Anaconda. JAMES J. DOUGHERTY. *Mining & Metallurgy*, Vol. 11, Aug. 1930, pages 389–391.

Presented before the Montana section April 7, 1930. A general discussion of developments in reverberatory smelting practice by the Anaconda Copper Mining Co., during the last 5 years. Deals briefly with changes in furnace types, in furnace feed, decrease in amount of slag produced, relation of slag assays to Cu loss in the slag, increase in grade of matte and furnace capacities. Gives a brief summary of topics discussed and conclusions derived therefrom. VSP(31)

Concentrate Hematites to Replace High-Order Ores. E. W. DAVIS (Mines Experiment Station, Univ. of Minn.). *Iron Age*, Vol. 126, Oct. 30, 1930, pages 1219–1220.

Abstract of paper presented at the Chicago meeting of the American Institute of Mining and Metallurgical Engineers, Sept. 1930. VSP(31)

Modern Methods of Ore Concentration. (Les methodes modernes de concentration des minerais.) CH. BERTHELOT. *Revue de Metallurgie*, Vol. 27, Oct. 1930, pages 535–543.

General principles of mineral concentration are given together with the description of principal methods including flotation. The installation for handling flotation wastes at Inspiration is described. The flow sheet and some details are given about the plant at Orb (Herault) using differential flotation and handling blende-pyrites-galena ores. JDG(31)

Ore Size and Blast-Furnace Economy. S. P. KINNEY. *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 472–475.

Reprinted from *United States Bureau of Mines Reports of Investigations*, Nos. 2982 and 2983. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 790. MS(31)

The Properties of Coke. *Iron & Coal Trades Review*, Vol. 121, Aug. 22, 1930, pages 253–254.

Abstract of a paper on "The Impact Hardness, Abrasion Hardness and Reactivity of Coke" read by R. A. Mott before the Midland Section of the Coke Oven Managers' Association. Discusses the "shatter" test, forces acting on coke in the blast furnace, nature of the coke and forces acting at the tuyères, drum-abrasive tests, and the reactivity of coke. Blast furnace coke should not be abradable. Hardness should be high. Hard coal is less liable to form breeze. Marked reactivity is not generally desirable in blast furnace coke. RHP(31)

Blast Furnace Versus Reverberatory. W. C. Davis. *Canadian Mining Journal*, Vol. 51, May 2, 1930, pages 410–413; *Metal Industry*, London, Vol. 37, July 11, 1930, page 1930.

A discussion of the relative merits of 3 current smelting methods and a suggestion as to future practice. Reflections center on the erection of a concentrator and reverberatory furnace plant at Copper Cliff for the International Nickel Company. Advantages and disadvantages of blast furnace and reverberatory furnace and the advances in reverberatory practice are pointed out. Also the value of sintering and the effect flotation may have in the induction of new smelting methods. VSP+WHB(31)

The Influence of Moisture Due to Leaking Tuyères on Blast Furnace Conduct. C. D. Abell. *Foundry Trade Journal*, Vol. 43, Oct. 9, 1930, page 247.

The moisture in the blast varies. The "winter" average is about 0.40 lbs./ft.^{3} and the "summer" about 0.60 lbs./ft.^{3} It is the only source of moisture which continually dilutes the reactions of the blast furnace. Moisture causes the formation of the Fe and Mn spinel oxides instead of the normal spinels (hercynite). Specific figures indicate losses of Fe, due to excessive moisture, presuming that equilibrium is obtained. Since this never proves practical, the figures simply indicate how disastrous the reactions can become, since it tends to give fusible scouring silicates, with the consequent occurrence in the hearth of pieces of apparently unreduced ore, consisting mainly of magnetic oxide of iron; and also accounts for the "slushy" or pasty character of the Fe cast when the furnace is running irregularly due to the presence of magnetic oxide (Fe_3O_4) in the iron. The direct results of excessive moisture is a regular working, low-temperature iron, with excess of sulphur and oxide, combined with poor fuel economy and an increase in the rate of furnace driving with lessened production. A factor of prime importance in this respect is the greater rate of combustion of hydrogen from the hydrogen-carbon monoxide mixture of the upper zones with attendant disorganization of the carbon monoxide dissociation reaction upon which the furnace depends for regularly economic working. The extent of the possible reactions is a function of the rate of driving, and the only remedy is to introduce more fuel and extra blast, if danger is suspected from a leaking member (0.50 lbs. water/100 ft.^{3} of blast is believed beneficial in most cases, by producing a certain amount of oxide in the iron. Above this figure it becomes a source of trouble.) WHB(31)

Concentration of Swedish Iron Ores. (Hüganrikning av svenska järnmalmer.) Gust. G. Bring. *Jernkontorets Annaler*, Vol. 114, Oct. 1930, pages 64–132, 12 references.

The concentration referred to is concentration to produce as nearly pure Fe mineral as possible. Magnetite ore can be concentrated successfully by magnetic separators and concentration tables. Hematite can be concentrated by concentration tables, by flotation, or by magnetic roasting. The concentration table causes too great losses. Flotation appears to require extremely fine grinding which adds too much to the expense. Roasting to convert Fe_2O_3 to magnetic Fe_3O_4 was finally resorted to, the reducing agent being air dried saw dust. It was found that the transformation took place with measurable speed at 400° C. but the speed increased up to 800° C. Cooling of the roast should take place as rapidly as possible for hematite and might advantageously be done in water since wet grinding is required. Limonites, however, should be cooled slowly in air from 400°–500° C. Microphotographs indicate that the magnetized roast is a mixture of Fe_3O_4 and FeO rather than a solution. Large scale tests using producer gas as fuel showed that a concentrate of over 69% Fe could be obtained. The heat requirements were found to be 10.4% by weight of wood for a 40% ore of which 30% is present as Fe_2O_3. For charcoal 4.8% by weight is needed. The product is in a very friable condition and easily crushed. Industrial installations have produced a concentrate with 68.32% Fe, and a 92.7%, recovery. HCD(31)

The Technical Conditions of Zinc Smelting by the Continuous Process. (Die technischen Bedingungen der Zinkverhüttung in kontinuierlich arbeitenden Systemen.) Herbert Cohn. *Metall und Erz*, Vol. 27, July 1930, pages 357–362.

Discusses the operation of vertical muffle furnaces, gas tightness of assembled muffle-columns, construction of charging and tapping openings, effect of slag, change in temperature and metal vapors on the lining. Describes the process of zinc smelting at Oberspree, of the New Jersey Zinc Co., and the Coley process. CEM(31)

Chain Filter Installed at Stock Line Curtails Dust Loss. Julius Stoecker. *Iron Trade Review*, Vol. 86, Feb. 6, 1930, pages 79–80.

Abstract from *Stahl und Eisen*, Sept. 5, 1929. MS(31)

Air Discharge of Circular Tuyères. Richard S. McCaffery & Daniel E. Krause (University of Wisconsin). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 385, 1931, 10 pages.

The adoption of divergent blast-furnace tuyères by a German plant has been reported to result in a decrease in blast pressure and increased output. Tuyères of different design were tested by casting samples 1/5 of the usual size and determining rate of air flow and air pressure at different points in front of the tuyères. Both the length and divergence of the tuyères affect the spreading of the emergent air. It is concluded that the benefits derived from the use of divergent tuyères are due to a better distribution of the air rather than to the immediate shape of the air stream. Contains 1 reference. JLG(31)

A Statistical Analysis of Blast-Furnace Data. Richard S. McCaffery & Roland G. Stephenson (University of Wisconsin). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 384, 1931, 13 pages.

Daily reports were obtained from 15 blast-furnaces. The data, including mineral composition of the slag, output, analysis of the iron, fuel consumption and moisture content of the air, were listed and classified by a tabulating machine. Slag compositions were expressed in mineral composition. In order to find the effect of one factor on another the cards were sorted into groups in which all other factors in each group were within rather narrow limits. The necessary data were then plotted. Increased Si in the iron is accompanied by a slight decrease in tonnage. The coke consumption per ton of iron is increased 100 lbs. for each 1% increase in Si. S elimination varies directly with Si in iron. The ratio of S in slag to S in metal increases with Si content of metal. Increased calcium bisilicate is accompanied by a decrease in S ratio. Contains 6 references. JLG(31)

Effect of Magnesia on Slag Viscosity. Richard S. McCaffery, Joseph F. Oesterle & Oscar O. Fritsche. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 383, 1931, Third paper, pages 55–68.

Data for this report was taken from the second paper in this technical publication. The viscosity of slags of definite composition and at definite temperatures are plotted on plane triaxial diagrams showing compositions of silica, lime and alumina on planes representing constant magnesia contents. Only part of the data are included in the report. Temperatures of 1400°, 1500° and 1600° C. and planes of constant magnesia content of 0, 5, 10, 15 and 20% were selected. The most striking fact observable from the vicosity diagrams is that with a higher magnesia content there is less change in viscosity when silica, alumina, and lime vary among themselves than there is with a lower magnesia content. A means for detailed study of the diagram is outlined. Sections along various alumina-silica ratio lines at 1400°, 1500° and 1600° show that the general effect of magnesia is to flatten the curves. In the same manner the effect of alumina and lime were illustrated. CHL(31)

Determination of Viscosity of Iron Blast-Furnace Slags. Richard S. McCaffery, Clarence H. Lorig, Ira N. Goff, Joseph F. Oesterle & Oscar O. Fritsche. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 383, 1931, Second paper, pages 27–54.

A report of an investigation to determine the relations between the viscosity, temperature and composition of that portion of the silica–alumina–lime–magnesia system within which blast-furnace slags are found. Except for the substitution of a square bob for the usual cylindrical spindle, the apparatus for measuring viscosities was of the Margules rotating cylinder type. The apparatus and its operation are described. Greater accuracy with the use of the square bob was reported. Synthetic slags with composition corresponding to various mineral compounds were made from the pure oxides lime, magnesia, alumina and silica. The minerals and mineral combinations were used in forming binary, ternary and quaternary mixtures of slag minerals. A complete table of the mineral composition, chemical composition and viscosity in poises at 1650°, 1600°, 1550°, 1500°, 1450°, 1400°, 1350°, 1300° and 1250° C. for 168 slags is given. A comparison of viscosities of slags in the ternary system silica–alumina–lime to those of Feild and Royster reported in their Slag Viscosity Tables show little in common. Various possible causes suggested to account for the discrepancies in the results of the 2 investigations are based on differences in technique and operation of the apparatus. The authors believe that improved design and manipulation incorporated in their apparatus lend themselves to greater accuracy in measuring the viscosity of molten slags. 26 references are cited. CHL(31)

Research on Blast-furnace Slags. A Progress Report. Richard S. McCaffery. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 383, 1931, pages 5–26.

Observations, tests and data obtained through research on iron blast-furnace slags now in progress at the Metallurgical Department of the University of Wisconsin are commented upon. The comments apply more specifically to viscosity determinations made on samples of synthetically prepared slags in the composition range: silica 25 to 55%; alumina 0 to 35%; lime 25 to 55%; magnesia 0 to 20%. The most noticeable thing observed was the effect of the magnesia in reducing the viscosity of slags. The possibility of greater regularity of furnace operation through use of high magnesia slags is brought out. Thirteen diagrams showing the effect of magnesia and alumina on the viscosity of slags with various constants are given. In this report the viscosity determinations on blast furnace slags are summarized in 3 series of diagrams. Temperatures of 1400°, 1500° and 1600°C. were selected. One series gives the viscosity in terms of the alumina-lime-magnesia compositions with silica varying 5%. Another series gives the viscosity of silica-alumina-magnesia compositions with lime varying 5% and a third series gives the viscosity of lime-magnesia-silica compositions with alumina varying 5%. The report contains a total of 79 diagrams. CHL(31)

Alkaline Cyanides in the Blast Furnace. W. McConnachie (Coltness Iron Works). *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1449–1450, 1454.

Same article that was published in *Chemical Age*, Vol. 22, April 5, 1930, Monthly Metallurgical Section, pages 21–22. MS(31)

Study of Iron Ore Sinter. G. M. Schwartz (University of Minnesota). *Blast Furnace & Steel Plant*, Vol. 18, March 1930, pages 462–467, 471.

From a paper read before the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers. MS(31)

Production of Artificial Manganese Ore. T. L. Joseph, E. P. Barrett & C. E. Wood (United States Bureau of Mines). *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 631–637.

From *American Institute of Mining and Metallurgical Engineers, Technical Publication* No. 310. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 687. MS(31)

Form of Copper in Converter Slag. *Metal Industry*, London, Vol. 36, June 20, 1930, page 650.

Summarizes results of investigation by F. S. Wartman and W. T. Boyer at the Southwest Experiment Station of the Bureau of mines, Tuscon, Arizona. VSP(31)

Iron-Ore Reduction in the Hot-Blast Furnace. Wm. McConnachie. *Iron & Coal Trades Review*, Vol. 121, Aug. 29, 1930, page 289.

Describes experimental work done by Bell to determine the effect of gases produced by the combustion of coke, or fixed C in the removal of O from the ore. Tests were made with a Clarence furnace using coke and a Lanarkshire furnace using coal. No O is removed from the ore by H in ordinary practice. Carbon monoxide also fails to remove an appreciable amount of O. Several theories have been advanced as to the removal of the O but none of them have been fully proven. The author suggests further research in the field using the small size coal burning furnace. RHP(31)

Use of Thermodynamical Data to Study the Chemical Reactions of Metallurgical Processes. R. S. Dean. *United States Bureau of Mines, Information Circular* 6395, 1930, 12 pages.

Examples are given to show how by the application of thermodynamic results new methods are proposed for deoxidation of copper, production of zinc and separation of zinc and cadmium. AHE(31)

NON-METALLIC COATINGS FOR METALS (32)

Effect of Furnace Gases on Quality of Enamels. A. I. Andrews & E. A. Hertzel. *Fuels & Furnaces*, Vol. 8, April 1930, page 511.

Abstract of paper read before the American Ceramic Society, Feb. 16–21, 1930. Investigation showed SO_2 in furnace gases is detrimental to enamels burned therein. Small white pock marks which could not be washed off with water were formed on sheet steel ground coats. White sheet steel cover coats were attacked in the same way, but the marks were more difficult to distinguish. Variations in composition of the ground coats produced little variation in the resistance to attack. Variations in the composition of cover coats in certain cases produced large variations in the resistance to attack. MS(32)

Effect of Furnace Gases Upon Vitreous Enamels. E. E. Geisinger & K. Berlinghof. *Fuels & Furnaces*, Vol. 8, March 1930, pages 357–358.

Abstract of paper read before American Ceramic Society, Feb. 16–21, 1930. Investigation of the effect of 100% concentrations of stable elementary gases and some mixed gases on ordinary steel enamels. O_2 gave enamels with excellent qualities, but the steel was excessively oxidized. The gases which were deleterious to enamels were: H, H_2O vapor, Cl, H_2S, NH_3, oil gas and SO_2, their harmfulness decreasing in the order given. MS(32)

Use of Conveyors in Japanning Ovens. W. J. Miskella. *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1077–1078, 1084.

Discusses construction and operating features of conveyor type japanning ovens. MS(32)

Finishing Automobile Tire Rims. E. H. Ledyard (Consumers Power Co.). *Metal Cleaning & Finishing*, Vol. 2, May 1930, pages 427–428.

In the plant of the Motor Wheel Corp., Lansing, Mich., rims are pickled in 5% H_2SO_4 bath, rinsed, rust-proofed by galvanizing and treating with antimony oxide, rinsed, and dipped in enamel, which is baked in a continuous conveyor at 375°–400° F. MS(32)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

401 **Costello Burner.**—A very complete description of their raw producer gas burner is given in a folder sent out recently by the Costello Engineering Co., 519 Oliver Bldg., Pittsburgh, Pa.

402 **Rolled Steel.**—Lukenweld Construction is the fabricated product obtained by welding Lukens rolled steel and is an efficient and economical method of manufacturing units such as housing, bases, beds, gear cases and other parts of machinery and equipment. This construction is fully discussed in a booklet prepared by Lukenweld, Inc., Coatesville, Pa.

403 **Steel Castings.**—The Industrial Steel Casting Company, Toledo, Ohio, has issued a series of folders illustrating the kind of machining job that can be done on their castings, and giving a number of views of their plant.

404 **Timbre.**—Technical Bulletin "C", prepared by the research department of the Carpenter Steel Co., Reading, Pa., is a 20-page report which defines "timbre" and tells how it affects the properties of carbon tool steel. The report contains a number of illustrations.

405 **Alloy Steel Valves.**—This new line of valves, manufactured by the Duriron Company, Inc., Dayton, Ohio, is especially applicable for those conditions of hard mechanical service where high pressures and high temperatures are encountered in transferring corrosive liquids and gases through pipe lines. They are described in a folder issued by the company. Their Bulletin 164 is devoted to Duriron Centrifugal Pumps.

406 **Ajax Seven Point Ingot.**—The Ajax Metal Company, Frankford Ave. & Richmond St., Philadelphia, Pa., has recently sent out to the trade a booklet giving detailed information on their non-ferrous ingots, both standard and special and includes a table giving the A. S. T. M. tentative specifications for standard alloys.

407 **Molybdenum.**—An attractive brochure gotten out by the Climax Molybdenum Co., 295 Madison Ave., New York, discusses thoroughly the effect of molybdenum on cast iron. It contains numerous tables and figures. This company has also published a book, "Molybdenum in 1930," presenting facts about the various uses and applications in industry of molybdenum. These technical data are from authoritative sources and free from advertising bias.

408 **All Metal House.**—The feature article of the Jan. 15, 1931 issue of the bulletin of the Copper & Brass Research Association, 25 Broadway, New York, concerns an all-metal, factory-made house being introduced in Germany. The whole issue is devoted to articles on recent developments in Germany in the employment of copper and its alloys in building construction.

409 **Annealing Furnaces.**—A broadside sent out by the Surface Combustion Corp., Toledo, Ohio, illustrates several of their annealing furnaces which have been developed to meet specific operating conditions.

410 **Wrought Iron.**—A quantity of interesting information concerning wrought iron has been collected by the Wrought Iron Research Association, Union Bank Building, Pittsburgh, Pa., and has been published in booklet form. It includes both technical and non-technical data.

411 **The Octagon.**—The feature article in the Jan. 1931 issue of this publication of the American Steel Foundries, Wrigley Bldg., Chicago, is "The Growth of the Locomotive" by W. G. Greene. Mr. Greene also has an article in the February issue entitled "Railroad Development in Spain."

412 **"Neor."**—This non-deforming high carbon-chrome steel is a product of Darwin & Milner, Inc., 1260 West 4th St., Cleveland, Ohio, and is described in a recent pamphlet, which includes general heat treatment instructions for this steel.

413 **Ingot Bronze.**—A brief covering physical properties and various data in connection with valve and metal ingots produced by the Tottenville Copper Co., Inc., Tottenville, N. Y., is available. This gives facts about ingot bronze for valves, meters, high-grade machinery castings or any work requiring a close-grain, easily machined metal.

414 **Carboloy.**—The Jan. 1931 issue of this publication contains a number of interesting articles, among them being "Application of Carboloy Tools to Facing Zinc Die Castings," "Reaming a Tapered Hole in Alloy Brass," and Rockwell-to-Brinell conversion tables. Carboloy Company, Inc., Detroit, Michigan.

415 **Diffraction X-Ray Apparatus.**—Bulletin No. 12, issued by the J. B. Hayes Machine Company, Urbana, Illinois, lists X-Ray apparatus manufactured by the company, including tubes, cameras and several types of cassettes.

416 **Hydro-Power.**—A broadside sent out by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, lists the standard sizes and capacities of their hydro-power presses.

417 **Lead.**—The March 1931 issue of this publication of the Lead Industries Association, 420 Lexington Ave., New York, tells about a number of interesting uses of lead among them being the use of lead pads to dampen machinery vibrations in a newspaper plant.

418 **Sandslingers.**—The Feb. 1931 issue of "Better Methods" is devoted to a discussion of this type of apparatus manufactured by the Beardsley & Piper Co., 2541 North Keeler Ave., Chicago, Ill.

419 **Electrodes.**—A folder issued by the International Graphite & Electrode Corp., Niagara Falls, N. Y., stresses the facilities, organization and policy of the company and announces the opening of their new plant.

420 **Fusion Facts.**—The leading article in the Jan. 1931 issue of this periodical is "Borium—Its Properties and Its Uses" by Miles C. Smith. Several interesting applications of Stoody products are discussed in other articles.

421 **Electric Heating Furnaces.**—Bulletin No. 5 of Ryan, Scully & Co., Philadelphia, Pa., describes and illustrates their portable box-type electric heating furnaces. These furnaces are the result of many years' research and practical experience. Bulletin No. 7, by the same company, discusses their butterfly type blast gates.

422 **Engineering Metals for the Process Industries.**—A pamphlet with this title has been gotten out by the International Nickel Co., 67 Wall Street, New York, and contains an article on the design and construction of heavy equipment in monel and pure nickel and reprints a number of advertisements of firms who use these metals in their products.

423 **Interferometers.**—Catalog No. 1, of the Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill., lists and describes the different forms of interference apparatus manufactured by the company.

424 **Dust-Collectors.**—A particular installation of one of their dust-collecting systems is discussed in Bulletin No. 20 of the Dust Recovering & Conveying Co., Harvard Ave. & East 116th St., Cleveland, Ohio.

425 **Manganese Steel.**—The Feb. 1931 issue of the Amsco Bulletin shows the use of manganese steel for dredge buckets all over the world. A number of other products of the American Manganese Steel Company, Chicago Heights, Illinois, are illustrated.

426 **Struthers-Weld.**—A page of micro-photographs showing the juncture between the parent metal and the weld metal has been prepared by the Struthers-Wells Co., Warren, Pa.

427 **Corrosion.**—An interesting article on the "Corrosion of Rivets in Marine Vessels" is featured in the Vol. 1, No. 4 issue of The Wrought Iron Record which is published by the Wrought Iron Research Association, Union Bank Building, Pittsburgh, Pa.

428 **Metallographic Polishing Machine.**—A folder sent out recently by the American Instrument Company, 774 Girard Street, N. W., Washington, D. C., gives an excellent description of their Automatic Metallographic Polishing Machine.

429 **Cadalyte.**—This booklet by the Grasselli Chemical Co., Cleveland, Ohio, gives the development of Cadalyte, a process and product for cadmium plating, and discusses the operation of the process in the plating room.

430 **Metal Spraying Process.**—This booklet by the Metal Spray Engineering Co., 3501 Croton Ave., Cleveland, Ohio, explains their method of spraying metals, gives a list of metals that can be successfully treated this way and suggests a number of objects which can be advantageously lined or coated by spraying.

431 **Gray Iron.**—Bulletin No. 1 of the Gray Iron Institute, Inc., Terminal Tower Bldg., Cleveland, Ohio, discusses the dome of the Capitol building which is made of gray iron. Bulletin No. 2 is a short essay on the gray iron work in the Holland Tunnel.

432 **Furnaces.**—Homo furnaces are successfully used for normalizing and heat treating bolts because they hit the predetermined correct temperature precisely and unfailingly. They are illustrated in a folder prepared by Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa. This folder also has a word about Hump hardening for drop-forge dies.

433 **The Laboratory.**—Among other interesting items, the Vol. 4, No. 1 issue of this periodical contains two pages of the temperature conversion tables compiled by Sauveur. The publishers are The Fisher Scientific Company, 711 Forbes St., Pittsburgh, Pa.

434 **Zinc.**—Two recent publications of the American Zinc Institute, 27 Cedar St., New York, N. Y., are Zinc and Its Corrosion Resistance, and Zinc Workers' Manual. The first of these presents in abstract form existing data concerning studies, investigations, tests, equipment and researches in this practical field of the use of zinc and is priced at $1.00. The Manual is devoted to the methods and practice of zinc roofing and may be had for $1.50.

435 **The Steel Founder.**—The March 1931 issue of this publication reprints an address by W. Trinks before the Steel Founders' Society at Columbus, March 19th, in which he discusses the "Selection of Materials in Machine Design." This is published by the Society, 932 Graybar Bldg., New York, N. Y.

436 **Meeting the Metal Requirements of Boatbuilding.**—A booklet with this title gotten out by the International Nickel Company, 67 Wall St., New York, is a very interesting discussion of the use of Monel metal in boatbuilding. Its resistance to corrosion in both salt and fresh water especially fits it for such use. Another of their pamphlets, "Modern Ideas in Food Plant Sanitation," illustrates the numerous uses to which Monel metal can be put in the canning factory.

437 **Fifty Years of Service to Industry.**—An extremely attractive brochure sent out by the Pittsburgh Testing Laboratory, Pittsburgh, Pa., describes the facilities and service of this institution with regard to physical testing, chemical analyses, engineering inspections and research.

438 **Better Heat.**—In the February issue of this publication of the Consolidated Gas Company of New York, 4 Irving Place, New York, there is a short summary of E. D. Milener's studies in the application of gas heat to forging and other uses as brought out in his address before the Rhode Island Chapter of the A.S.S.T.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS OF METALS & ALLOYS

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These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

Book Reviews are included below and marked by -B-

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PATENT SERVICE

Until we resume regular publication in September, the service rendered by the Patent Department of METALS & ALLOYS will be carried on by Mr. W. M. Corse, 810 Eighteenth Street, Washington, D. C. who can supply copies of United States and foreign patents and translations at reasonable costs.

GENERAL (0)

Tool Steel Progress in the Twentieth Century. JOHN A. MATHEWS (Crucible Steel Co. of America). *Iron Age*, Vol. 126, Dec. 4, 1930, pages 1672–1676.

Abstract of paper read before the New York chapter of the American Society for Steel Treating, Oct. 13 and the Syracuse chapter, Dec. 3. The twentieth century may fittingly be called the "Alloy Age." High-speed steel was introduced in 1900. High-speed steel and the electric furnace are the outstanding events responsible for the progress of the last 30 years. C-V tool steels, Cr-V, Ni-V and Ni-Cr-V structural alloys and V-high-speed steel were produced about 1903. Carborundum production introduced by E. G. Acheson constitutes an early development of commercial electric furnace work. Electric furnace has functioned in 2 ways: (1) in direct melting process for the steel itself, and (2) in smelting process. First electric furnace installed by the Halcomb Steel Co., Syracuse in 1905. Demand for steels for dies and tools resulted in development of W hot die steels. No oil-hardening die steel available before 1905. Principal purpose of research in steel industry is to increase profits. VSP(0)

The "Launching" of Magnesium. (Le "demarrage" du magnesium.) C. D. *Journal du Four Electrique*, Vol. 39, Sept. 1930, pages 325–326.

General information regarding the introduction of Mg into metallurgical uses. JDG(0)

Physics as an Aid to Metallurgy. REPUBLIC RESEARCH CORPORATION. *Iron Age*, Vol. 126, Oct. 16, 1930, pages 1066–1067, 1117–1119.

There is no theoretical method by which it is possible to get the true properties of metals. Fundamental considerations of physics are valuable in suggesting further experimentation. An organization whose duty is to develop processes for production in a manufacturing organization must have a staff of physicists, physical chemists and metallurgists. One of the most interesting recent developments of physics, which is applicable in metallurgy, is X-ray diffraction work. VSP(0)

Report of American Society for Testing Materials Special Committee on Promotion of General Use of Specifications for Copper Alloys in Ingot Form. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 412–414.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. (0)

Aeronautical Research. *Engineering*, Vol. 130, Oct. 17, 1930, pages 483–484.

Comments on Report of Aeronautical Research Committee for 1929–1930 recently published by His Majesty's Stationery office. Among problems discussed is that of increased use of metals in aircraft constructions. Corrosion of Al alloys and means for its prevention are important problems. Mg alloys and Be have been considered but as yet they are inferior to Al alloys. Al alloy castings has been greatly improved by grain refinement and gas removal from melts. For this, the use of titanium tetrachloride has been satisfactory. LFM(0)

Science and Electrical Engineering. E. W. MARCHANT. *Engineering*, Vol. 128, Oct. 25, 1929, pages 536–537.

Abstract of paper read before the Mersey and North Wales (Liverpool) Centre of the Institution of Electrical Engineers. Reviews advances made in electrical engineering due to contributions of pure science. Discovery of Si iron has caused progress to be made in transformer design and construction. Use of Co steel has led to revolution in design of permanent magnets. Great benefits have been derived from use of Ni-Cr alloys in electric heaters. Discovery of Permalloy has enabled speed of transmission in telephone and telegraph cables to be increased 4 to 5 times. LFM(0)

Science and the Iron and Steel Industry. ARTHUR D. LITTLE (Arthur D. Little, Inc.). *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1126–1129, 1134; *Heat Treating & Forging*, Vol. 16, June 1930, pages 738–742; Condensed in *Rolling Mill Journal*, Vol. 4, May 1930, pages 209–211.

Paper read before American Iron & Steel Institute, May 9, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. MS(0)

Metallurgy Encounters New Problems. L. M. JORDAN. *Heat Treating & Forging*, Vol. 16, Jan. 1930, pages 75–76, 131.

Outlines some of the contributions of metallurgy to the development of materials for automotive and aircraft engines. Much remains to be done in improving the properties of metals so that failures will be rare. MS(0)

Bessemer Output Becomes More Important. JOSEPH R. MILLER. *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 973–974.

Certain steel products are best made from Bessemer steel. Bars may be easily welded and be stronger and stiffer than equally good welding grades in open-hearth steel. Bessemer steel threads more easily and it has not been equaled as a free cutting steel. Attention is being paid to improvement of quality. Trend in vessel design is toward comparatively greater diameters with less depth of metal above the tuyères. In general, satisfactory Bessemer Fe will blow with about 18,000 cu. ft. of air/ton of metal. Blast pressures are about 25 lb./in.^{2} or 22 lb./in.^{2} Bessemer Fe should contain 0.80–1.40% Si (this being somewhat higher in summer than in winter), not more than 0.60% Mn, and under 0.090% P. MS(0)

Nickel and Its Alloys. A. J. WADHAMS. *Mining and Metallurgy*, Vol. 10, April 1929, pages 183–189.

A paper read before the Spring Meeting of the American Institute of Mining and Metallurgical Engineers gives a historical survey of the development of nickel and its alloys from earliest times to the present day, and contains brief notes on the results of early research and a review of post-war expansion in the nickel industry. The summary which is given of present-day applications of nickel and its alloys forms a striking statement on the wide range of industries in which nickel is playing an important part. Reference is made to the use of ferro-nickel alloys of high magnetic permeability, of non-magnetic alloys of iron and nickel in the electrical industry, of nickel in constructional steels, of heat- and corrosion-resisting alloys containing varying percentages of nickel, of "nickel silver" for cutlery and tableware, and of the numerous applications of nickel as a modifying element in a number of ferrous and non-ferrous materials. Reference is also made to the use of nickel as a catalyst in the preparation of edible oils, as an active material in storage batteries, in coinage, and in the form of electrodeposited coatings. The paper closes with some comments on recent developments in connection with the mining of nickel-copper ore at Sudbury, Ontario. (0)

Manufacture of Die Blocks. J. P. BINDYKE (Heppenstall Company). *Heat Treating & Forging*, Vol. 16, July 1930, pages 864–868, 880.

Description of the open-hearth, forging and heat treating practice of the Heppenstall Co. MS(0)

Current Vogues in Metals. HERBERT CHASE. *American Machinist*, Vol. 73, Sept. 18, 1930, pages 479–481.

Brief information concerning various metals now in use, mostly of the non-corrosive type. Gives type of metal, approximate percentage of the chief alloy and some uses. Material not original but gleaned from various sources. RHP(0)

Developments in Nickel Iron and Steel. CHARLES MCKNIGHT (International Nickel Co.). *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 968–970; July 1930, pages 1149–1151. Condensed in *Iron Trade Review*, Vol. 86, May 29, 1930, pages 45–47, 61. Abstracted in *Rolling Mill Journal*, Vol. 4, May 1930, page 218; *Metal Stampings*, Vol. 3, June 1930, page 526.

Paper read before American Iron & Steel Institute, May 9, 1930. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 687. MS(0)

Developments of the Past Year in Metal Finishing. WILLIAM J. MISKELLA (Finishing Research Laboratories, Inc.). *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 59–62.

Deals with equipment and materials. MS(0)

Metallurgical and Chemical Progress in British Columbia During 1930. F. H. MASON. *Canadian Chemistry & Metallurgy*, Vol. 15, Jan. 1931, pages 30–31.

A review. WHB(0)

PROPERTIES OF METALS (1)

Recommended Specifications for Analytical Reagent Chemicals. Sodium Metal. COMMITTEE ON ANALYTICAL REAGENTS, AMERICAN CHEMICAL SOCIETY. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, pages 351–354.

The requirements of purity of sodium metal and the tests for determining these requirements are listed. Requirements for metal salts are also given in this article. MEH(1)

Copper—Cuprous Oxide Eutectic and Density of Copper. (Kupfer—Kupferoxydul und dichte des Kupfers.) W. STAHL. *Metall und Erz*, Vol. 27, Aug. 2, 1930, page 414.

The Cu-Cu_2O eutectic occurs at 96.5–96.6% Cu and 3.4–3.5% Cu_2O at 1065° C. Density determinations give for raw Cu 8.4864 and 8.6078, and for the eutectic 8.7312. (1)

Electrical Conductivity of Pulverized Metals under Pressure. (Die elektrische Leitfähigkeit pulverförmiger Metalle unter Druck.) F. SKAUPY & O. KANTOROWICZ. *Metallwirtschaft*, Vol. 10, Jan. 16, 1931, pages 45–47.

A summary of an investigation. The electrical resistance of a compressed metallic powder is higher than that of the compact metal, the difference being greater for hard than for soft metals. The resistance depends both on the amount of pressure and the time of its application, also on the preliminary treatment of the powder. The resistance-pressure curve is non-reversible. With reduced pressure the resistance remains for a time at the minimum, then slowly increases and usually does not return to the original value for no pressure. After repeated pressure applications the resistance of some metals, increases, of others decreases. Some variations from Ohm's law were noted. Fine grained metal powders, with few exceptions, had a higher resistance than coarse grained powders. The temperature coefficient of the resistance is strongly negative with zero pressure, but at higher pressure is negative with rising and positive with lowering temperature. CEM(1)

Physical and Mechanical Properties of Nickel. P. D. MERICA. *Transactions, American Society for Steel Treating*, Vol. 15, June 1929, pages 1054–1059.

The Recommended Practice Committee of the American Society for Steel Treating has published a data sheet covering the physical and mechanical properties of nickel. The information has been compiled by P. D. Merica, and is based on a consensus of the best data available from published and unpublished sources. It is pointed out that since the composition and structure of nickel may vary appreciably, the physical and mechanical values given in the data sheet must be regarded as typical and average values only. Data are presented relative to commercial nickel and to nickel of specially high purity, and an indication is given of the number of determinations upon which any value is based. (1)

Electron Reflection by Passive Iron. I. (Elektronenbeugung an passivem Eisen. I.) E. RUPP & E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 78–80; *Naturwissenschaften*, Vol. 18, 1930, page 459.

The method of study of a surface by allowing a stream of electrons to impinge upon it at a constant angle, varying the speed of the electrons by varying the voltage of the electron source, and noting the maxima in the reflections, has been applied by Rupp and Schmid to single crystals of iron, to the same crystals made passive by HNO_3, to the same oxidized by steam, and to haematite and magnetite, in the hope of showing the nature of the oxide layer on the surface. The reflections from the passive or oxidized surfaces are quite different from those from the iron crystal itself. The maxima in the reflections from the passive layer are inter-related. The constant calculates out to be of the order of 3.4 A. U. Bombardment of the passive layer with fast electrons heats the specimen and alters the layer so that it no longer gives the same reflection curve. The maxima for the passive layer do not match up exactly with those for either Fe_2O_3 or Fe_3O_4. Further work on other oxides and hydroxides is planned. The authors say that their work gives no support for the theory that the passive layer is a 3 dimensional structure of an oxide or hydroxide, nor does it directly prove its nature as a two-dimensional film. HWG(1)

Vanadium, Niobium and Tantalum. A Textbook of Inorganic Chemistry (Ed. by J. Newton Friend), Vol. VI, Part III. SIDNEY MARKS. Charles Griffin & Co., Ltd., London, 1929. Cloth, 6 × 9 inches, 222 pages. Price $10.00.

This volume adds another to the very small group of reference works describing these metals, and that possess true utility. It will serve the chemist more adequately than it will fill the needs of the metallurgist but, of course, has been prepared essentially for the former's use.

It is to be regretted, however, that so many reference works should reflect a most painstaking survey of the literature without any equally strong effort to assemble the data as a critical review. One finds, therefore, repetitions of old misinformation which could be so simply avoided by reference to those research workers and industrial concerns who are in possession of and always eager to transmit the truth. There are, likewise, occurrences of quotations of diametrically opposed data or experiences. For example, at the very outset it is stated that these metals have properties "associated with great hardness" while later describing individually their excellent malleability. In fact, vanadium is referred to as having a hardness of 7.5 on the Mohr scale and unable to be scratched by quartz while just below in the same paragraph is noted that it can be cold-rolled into wire. Another instance is that of the density of niobium which is given as 12.7, while in the immediately following sentence the statement is made that impure varieties show values of 7.06 to 8.4; this would seem to involve rather heavy additions of other elements that could hardly be described as impurities.

The methods of extraction and the uses of the metals are, however, in general, more precisely and completely stated than in most reference works. Among the more serious omissions are the failure to mention the direct reduction of vanadium ore by carbon in the electric furnace now producing a large proportion of the world's supply and the use in Europe of ferro-alloys containing over 50% vanadium. Except in the case of the uses of tantalum, the patent literature seems to have been slighted while in this instance it appears to be very carefully covered. For example, tantalum-gold alloys are mentioned but vanadium-gold alloys do not appear although the complete binary system was patented in 1914.

As noted above the chemistry of the elements and particularly of their inorganic compounds is very admirably described—particularly in respect to the chemical (and physico-chemical) behavior of all 3 metals and the preparation of their compounds. The portions devoted to the heteropoly-acids of the metals and the other very complex compounds, more especially of vanadium, the nomenclature and classification of the salts of vanadium, and the electromotive behavior of niobium and tantalum are particularly to be commended. But one serious chemical error exists. Reference is made to the red amorphous and red crystalline forms of vanadium pentoxide and the instability of the yellow amorphous variety. Actually, the pure oxide is always yellow. When fused, the surface takes on a very dark reddish brown tone but this is an alteration, whether physical or chemical, that influences only a microscopically-thin layer as by the slightest abrasion the yellow color reappears. The commercial oxide, on the other hand, varies from brilliant red to very deep brown due to the presence of impurities and lower oxides.—Jerome Strauss (1)-B-

Electrical Conductivity of Copper (Ueber die elektrische Leitfähigkeit von Kupfer.) G. ELSNER & P. SIEBE (Osnabrucker Kupfer- & Drahtwerk). *Zeitschrift für Metallkunde*, Vol. 22, Dec. 1930, pages 397–401.

Influence of cold working and heat treatment upon electrical conductivity of Cu was investigated. The following materials, the complete analyses of which are given, were employed: American Wirebars with 99.9% Cu, electrolytic copper of 99.8% and 2 brands of Cu refined in the reverberatory furnace of 99.8% and 99.64% purity. The copper wires were annealed at various temperatures from 100–800° C. The deformation range covered 30 to 97%. A maximum of conductivity was established at medium temperatures. This range of maximum conductivity is shifted to lower temperatures by an increasing amount of impurities. The authors suppose a relationship between the structural properties of Cu and the loss on conductivity beyond the peak value mentioned. At higher annealing temperatures, the electrical conductivity of copper increases in contrast with the refined metal which in some cases yields a considerable loss. In general cold working of Cu causes a reduction in electrical conductivity. Differences in resistance due to preceding heat-treatments are more or less annulled by severe cold working according to the purity. The compensating effect of cold work is retarded in the impure grades of refined copper which effect is ascribed to segregation phenomena. In conclusion the authors compare their own findings with former publications on the subject and try to explain contradictions encountered in regard to the location of the peak value and the slope beyond it. EF(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Strong Alloys Promote Use of Aluminum Forgings. *Iron Trade Review*, Vol. 86, June 5, 1930, pages 71–74.

Deals with forging practice of the Aluminum Company of America. Alloy 17S is used to a limited extent, 25S and 51S being used for the majority of forgings. Relative forgeability is respectively 3:2:1. Relative machinability is 2:2:1. Heat treated in 2 steps. Solution heat treatment consists in heating at about 960° F. for 12 hrs. and quenching. Aging consists in heating to 300° F. for 18 hrs., if 25S or 51S is used. If 17S is employed, aging takes place at room temperature. As Al forgings are more plastic if only solution heat treated, straightening, compressing, and sizing are done before aging. Heavier hammers than those employed in forging steel are used. Properties and composition of the alloys in the heat treated and aged condition are:

Alloy	Approximate Composition, % Cu	Mn	Mg	Si	Al(min.)	Tensile Strength, lbs./in.²	Yield Point, lbs./in.²	Elongation, % in 2 in.	Brinell hardness, 1000 Kg. Load, 10 Mm. Ball
17ST	4.0	0.5	0.5	...	92.0	55000–63000	30000–40000	18–25	90–105
25ST	4.5	0.8	...	0.8	92.0	55000–63000	30000–40000	16–25	100–120
51ST	...	...	0.6	1.0	96.5	40000–50000	30000–40000	12–18	90–100

MS(2)

Some Properties of Silicon-"Aluminium-Bronzes." L. J. BRICE (Woolwich). *The Institute of Metals, Advance Copy* No. 547, 1931, 18 pages.

The effect of Si on the mechanical properties of Cu base alloys containing 5, 7¼ and 10% Al was determined. The alloys were tested as cast, as cast and annealed by heating to 800° C. followed by air cooling, as quenched in oil from 800 or 600° C., and a few as forged. Si contents were as high as 4.5%. With 5% Al the addition of up to 2% Si improves the properties. Further increase of Si increases strength but lowers ductility rapidly. An annealed 5% Al, 3.5% Si alloy has the properties of a 10% Al alloy. The addition of up to 4% Si to the 7¼% Si alloy progressively increases strength and decreases ductility. With more than 3% Si the ductility is so low as to render the alloy useless. The addition of even 1% Si to the 10% Al alloy produces a very low ductility. A microscopic study of the alloys is included. Contains 10 references. JLG(2)

Secondary Aluminum and Aluminum-Alloys and Their Utilization (Umschmelz-aluminium und-Aluminiumlegierungen und ihre Verwendung.) R. STERNER-RAINER. *Zeitschrift für Metallkunde*, Vol. 22, Aug. 1930, pages 269–272.

Qualitative and quantitative survey of the Al-scrap metal market during a long period of time led to the production of 3 grades of secondary aluminum by melting Al-scrap. The latter is converted into the following standards: (1) sand casting alloys with 5–7% Zn, 3–4.5% Cu; (2) chill casting alloys with 2–3.5% Zn and 6–8% Cu; (3) die casting alloys with 2.5% Zn maximum and 6–8% Cu. These alloys worked and heat-treated show a favorable machinability and may be substituted for other more expensive alloys. EF(2)

Report of American Society for Testing Materials Committee B-5 on Copper and Copper Alloys, Cast and Wrought. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 407–411.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (2)

Report of American Society for Testing Materials Committee B-2 on Non-Ferrous Metals and Alloys, with Report of Sub-Committee XV on Die-Cast Metals & Alloys. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 1, 1930, pages 315–333.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. (2)

Silberit and Ultralumin—Two New Light Alloys. (Silberit und Ultralumin—Zwei neue Leichtmetalle.) *Deutsche Goldschmiede-Zeitung*, Vol. 33, Dec. 20, 1930, page 7.

These 2 alloys are suitable for use in jewelry without plating. Silberit contains Al, Ni and Ag. Ultralumin contains more than 90% Al, Ni, Cu and some rare earth of the thorium group. Exact compositions not given. Ultralumin is especially resistant to sea water. JLG(2)

Some New Industrial Calcium Alloys. (Zur Kenntnis einiger neuer technischer Calciumlegierungen.) JULIUS MEYER & RUTH GORALCZYK. *Zeitschrift für angewandte Chemie*, Vol. 43, Feb. 15, 1930, pages 149–154.

A report on experimental study made at the Department of Chemistry at the University of Breslau on the reactive power of alloys of Ca with Mg, Al and Zn and on the speed of their reacting with other elements. Eight alloys of Ca containing the following percentages of other metals were examined: 37.5, 30 and 20% Mg; 40% Al; 50, 35 and 30% Zn; and 15% Mg and 15% Zn. All were gray-white powders, their brittleness varying with their composition, somewhat sensitive to the action of air and moisture, and even spontaneously combustible. When ignited, CO_2 must be used to extinguish them as the addition of H_2O may even lead to explosions. Ca-Al alloys are most stable in air. These alloys could not be used to dehydrate alcohol. Experiments upon specific gravity, rate of liberating H when treated with H_2O, acids and salts in solution are reported. The nature of the anion is most important in causing such reactions, chloride hastening them and nitrate slowing them. Reducing reactions with Ca-Zn alloys are slower than those with the Ca-Mg alloys. Amalgams of Ca alloys increase the reducing power but little. The use of Ca alloys instead of pure Ca as reducing and raising agents in the making of light-weight concrete is discussed. (2)

A New Silicon-Zinc-Copper Alloy. E. VADERS. *Engineering*, Vol. 130, Sept. 26, 1930, pages 387–388.

Abstract of paper read before the Institute of Metals, Southampton, Sept. 11, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. LFM(2)

Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys. E. VOCE. *Engineering*, Vol. 130, Oct. 3, 1930, pages 441–443.

Condensed from paper read before the Institute of Metals, Southampton, Sept. 11, 1930. *See Metals & Alloys*, Vol. 1, Dec. 1930, page 899. LFM(2)

Bearing Metals. *Machinery*, London, Vol. 35, Feb. 20, 1930, page 671; March 6, 1930, pages 743–744.

The first of these articles gives the composition and properties of yellow metal bearing alloys and copper-tin bearing alloys containing lead. The second discusses the properties and composition of tin-base alloys, lead-base alloys, zinc-base alloys, and lead-base barium alloys. (2)

Aluminium Sheet Production. Part 3, Melting Furnaces. ROBERT J. ANDERSON. *Metallurgia*, Vol. 3, Dec. 1930, pages 53–56.

A description of furnaces used in melting Al and its alloys prior to fabrication into sheets. Oil or gas fired furnaces are usually more suitable than electric furnaces. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 29. JLG(2)

Thermal Treatment is Indispensable for Aluminum and Light Aluminum Alloys. (Les traitements thermiques sont indispensables a l'aluminium et aux alliages legers d'aluminium.) J. SUHR. *Revue de Metallurgie*, Vol. 27, Oct. 1930, pages 563–569.

Aluminum (99.5 Al) is affected in its conductivity by the temperature of working and thermal treatment it might receive. The variations in conductivity obtained were within the range 58.6 and 62.6% of the conductivity of Cu. A pronounced improvement in physical properties, particularly in resistance to repeated impacts, can be produced in Al-Cu alloys by heat treatment. Eight percent Cu alloy soaked for 2 hrs. at 525°, quenched in water and drawn for 15 hrs. at 100° had its resistance to repeated impacts raised from 450 for cast specimens to 9395. A 12% Cu alloy had its impact resistance changed by the same treatment from 54 to 256, while the same thermal cycle resulted for a 4.5% Cu alloy in the increase of the resistance from 402 to 8635. An alloy containing 0.36 Fe, 0.35 Si, 4.17 Cu, and 0.4 Ti soaked for 2 hrs. at 510°, quenched in water and drawn at 190° for 4 hrs. changed the original value of 48 to 6442. Alpax type alloys are not improved by the heat treatment. An alloy containing 4.5 Cu and 0.4 Ti soaked at 525° for 5 hrs., quenched in water and drawn at 150° for 9 hrs. was able to show 18910–28997 as impact resistance instead of the original 312. The new alloy, Eutectal, patented by Rolls-Royce (1.5 Cu, 0.80 Mn, 1.58 Mg_2Si, about 0.25 Si and 0.35 Ti) can be made to give impact resistance of 12000–16000 after soaking for 5 hrs. at 525°, quenching in water, and aging for 5 days at room temperature. The same metal subjected to the above treatment in which aging is replaced with a draw at 150° for 9 hrs., gives an average impact resistance of 25,000. Its resistance in the cast state is 70. Physical properties produced by different treatments are given for all alloys. JDG(2)

Shaping and Annealing Treatment of Copper and Copper-Zinc Alloys. MENDL. *Metal Industry*, London, Vol. 37, Sept. 5, 1930, pages 217–220.

Abstracted from an article "Spanlose formung und glühbehandlung von Kupfer und Kupfer-Zink-Legierungen" in *Metallwirtschaft*, Vol. 9, No. 12. Hot deformation of Cu can be carried out over a wide temperature range, 700° to 900° C. Choice of temperature is guided by the following principles: The greater the surface in relation to volume, the more rapidly the material will cool during working. Although easier to heat up, it must be kept at higher temperature. The influence of speed of deformation is varied. For cold deformation annealed material is used. Clean annealing is important. Most common method consists of air-tight packing of the metal in an annealing pot. Material to be annealed should be wrapped in Cu. Grain size of normally annealed Cu is 0.01–0.08 mm. diameter. When overheated it rises to 0.1–0.4 mm. Role of impurities in Cu. Most important alloys of Cu are those with Zn. Equilibrium diagram shows the 63–37 alloy to be an α-brass but that the β-crystals form at about 700° C. If Cu content falls to about 62% β-crystals form at 600° C. α-Crystal is readily worked cold. Admixture of Pb exerts considerable influence on ease of hot working. Origin of the stresses. Stresses may be removed by deformation opposed to previous cold deformation and by heating. VSP(2)

Mechanical and Physical Properties of Magnesium Alloys. S. L. ARCHBUTT (National Physical Laboratory, England). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 251–256, 7 references.

Compilation of properties, in some cases up to 500° C. of pure Mg alloys with 6% Al, 3% Cu, and with 4.4% Zn plus small amounts of Al and Cu, in the wrought condition and, at ordinary temperatures, of a variety of cast alloys of Mg with various amounts of Zn, Al, Cu, Cd, Mn as alloying elements. HWG(2)

Melting Points of the System Tungsten–Rhenium. (Ueber die Schmelzpunkte im System Wolfram–Rhenium.) KARL BECKER & KURT MOERS. *Metallwirtschaft*, Vol. 9, Dec. 26, 1931, pages 1063–1066.

Contains 10 references. W and R are the 2 metals with highest melting points. The melting points of their alloys were determined by the method of Agte and Alterthum and they were examined microscopically and by X-rays. An intermetallic compound W_2R_3 with m. p. 3280° abs. is formed. This forms a eutectic with 50 atom % of R, m. p. 3165° abs., and with 67 atom % R, m. p. 3095° abs. W_2R_3 is slightly soluble in W with a 1.4% contraction of its lattice. It was not found to be soluble in R, but both W and R are soluble in W_2R_3. Seven photomicrographs of W-R alloys are given. CEM(2)

Deflection Due to Temperature of Bi-Metallic Strips of Any Curved Shape. (Temperaturausbiegung von Bimetallstreifen beliebiger Kurvenform.) K. BECKER. *Forschung und Technik*, 1930, pages 340–348.

The locus of the free end of a bi-metal strip, which is clamped rigidly on one end and has any given shape, is determined as a function of shape and temperature. The function is theoretically derived and simplified for the case of a small increase of temperature (initial deflection). The derived functions are evaluated for the straight strip, half-circle and full circle and the temperature-sensitivity is defined. The initial deflection and the temperature-sensitivity are calculated for one leg of a U-shaped strip, held in the U-point. This problem is often met with in practice, as these arrangements are used for thermal relays. An example is shown where a straight strip is heated until it assumes the shape of a full circle. Calculation and test show a close agreement. Ha(2)

Thermal Properties of Different Groups of Alloys. (Die thermischen Eigenschaften verschiedener Legierungsgruppen.) A. SCHULZE. *Giesserei-Zeitung*, Vol. 27, Apr. 1, 1930, pages 177–184.

A description of thermal expansion (dilatometry) and its relation to the constitution of alloys and the method of investigation. Discusses the relations between heat conductivity and constitution. Notes on magnetic properties of alloys and X-ray analysis by which the fine structure of alloys is rendered visible are included. (2)

Contribution to the Knowledge of the Elastic Properties of Light Metals. (Beitrag zur Erkenntnis der elastischen Eigenschaften der Leichtmetalle.) H. SIEGLERSCHMIDT. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 40–44.

See *Metals & Alloys*, Vol. 1, Feb. 1930, page 382. (2)

PROPERTIES OF FERROUS ALLOYS (3)

Gray Iron Possesses Valuable Engineering Properties. Pt. 8. *Foundry*, Vol. 58, Aug. 1, 1930, pages 110–113.

Discusses the application of formulas for evaluation of undetermined properties of gray Fe from known factors. Four major factors which determine properties of gray Fe are: chemical composition (initial, incidental and final), physical and structural make up of charge, temperature and atmospheric conditions encountered during melting process to moment of ingress in mold, and cooling rate from pouring time to room temperature. Explains the limitations of applying such formulas and cites works of various investigators. Contains a number of graphs. VSP(3)

Develops an Easily Machinable Corrosion-Resisting Steel. *Iron Trade Review*, Vol. 86, June 5, 1930, pages 80–81, 121.

Describes work of Bethlehem Steel Co. with corrosion-resisting steels. Have developed an alloy, known as Bethalon, which machines like ordinary screw stock. MS(3)

Report of American Society for Testing Materials Committee A-7 on Malleable Castings. *Proceedings American Society for Testing Materials*, Vol. 30, 1930, Part 1, pages 253–254.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (3)

Report of American Society for Testing Materials Committee A-1 on Steel, with Appendix. Proposed Revisions in Standards and Tentative Standards for Steel. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 80–92.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (3)

Report of American Society for Testing Materials Committee B-7 on Light Metals & Alloys, Cast & Wrought. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 415–416.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (3)

High Heat Expansion Cast Iron Developed for Cylinder Linings. *Automotive Industries*, Vol. 63, Nov. 1, 1930, pages 656–657.

The properties of the new heat and rust resisting gray cast iron alloy Ni-resist are dealt with in detail. GN(3)

Pearlitic Stainless Steel Castings. (Ueber den perlitischen rostfreien Stahlguss.) V. ZSAK. *Giesserei*, Vol. 17, Apr. 4, 1930, pages 339–342.

Consideration of the influence of different alloying elements on the properties of stainless steel castings; the composition and physical properties; the manufacture and use of pearlitic stainless steel castings. (3)

Copper Steels Improved by Heat Treatment. *Iron Age*, Vol. 126, Aug. 28, 1930, page 551.

Notes on papers read by Franz Nehl and Herbert Bucholtz before the Verein Deutscher Eisenhüttenleute and published in *Stahl und Eisen*, May 15, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 792. VSP(3)

Rustproof Steels. (Rostsichere Stähle.) ALFRED NAUCK. *Zeitschrift Feinmechanik und Präzision*, Vol. 38, Dec. 31, 1930, pages 3–4.

Short description of the composition and the fields of application for German steels V1M, V5M, V3M, V2A, V4A and V6A. Properties and treatment are also briefly given. Ha(3)

The Highly-Alloyed Steels in Aircraft Construction. JEROME STRAUSS. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 41–47; see also *Steel*, Vol. 87, July 17, 1930, pages 52, 54, 60.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. (3)

High Duty Cast Iron. (Hochwertige Gusseisen.) GEBRÜDER SULZER (Winterthur, Switzerland). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 49–63.

A cast alloy of about 1% C, $2^3/_4$% Si, 1% Mn, free from graphite, cast in a $^3/_4$" plate, has a tensile strength of nearly 100,000 lbs./in.^{2} This is the strength of the pearlitic ground mass of high-strength cast iron. The addition of alloying elements does not materially alter the strength of the ground mass itself, though they generally increase the hardness. The strength of the cast iron of course depends both on the matrix and the amount and distribution of graphite. The strongest graphite containing alloy of hardness below 310 Brinell (still machinable) of a series of 20 cast irons was one of 2.66% total C, 3.10% Si, 0.32% Mn, 0.08% P, 0.02% S, which had 69,500 lbs./in.^{2} tensile strength, 269 Brinell, 100,000 lbs./in.^{2} bending strength, 0.6" deflection (apparently on a 1.2" diameter bar, $23^1/_2$" centers). One with $2^1/_2$% total C, 3% Si gave nearly as high figures. Still lower carbon irons have higher tensile strength, but are more likely to have internal defects. Several highly alloyed cast irons containing Ni, Cr, W, Mo, V and Ti were tested (one contained a total of $4^3/_4$% of these elements), but were not superior to the unalloyed irons cited, in static properties. They may, however, be more wear-resistant. HWG(3)

The Relative Merits of Some Different Alloy Steels with Respect to Certain Mechanical Properties. BRADLEY STOUGHTON & WILBER E. HARVEY. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 241–277.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 843. (3)

Bessemer Steel, Its Properties and Use. J. R. MILLER. *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1602–1605.

Properly made Bessemer steel with P not over 0.10% has greater stiffness and higher tensile strength than open-hearth steel with the same C content and possesses superior machining, threading, welding and wear-resisting qualities. Its principal fault is brittleness under shock and in cold working, this being particularly marked in the heavy rolled sections. It is, therefore, necessary to be sure that it is applied only where it will fulfill the requirements. Tabulates the purposes for which Bessemer and open-hearth steels are used, giving sections and sizes and the analyses of the principal Bessemer grades. It would seem, as far as the bar sizes are concerned, Bessemer steel should hold an almost equal place, in point of quantity, with open-hearth steel if it were available in proper quality in such quantities. MS(3)

Physical Properties of Hadfield Steel. V. N. SVECHNICOV. *Heat Treating & Forging*, Vol. 16, July 1930, pages 881–886, 892.

Translated by T. P. Tolmachoff from the *Journal of the Russian Metallurgical Society*, 1929, No. 1. Contains some foot-note additions by the author. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 338. MS(3)

The Change of Density in Iron and Steel Caused by Cold-Working and by Tempering. K. TAMARU. *Science Report, Tohoku Imperial University*, Series I, Vol. 19, 1930, pages 437 to 448.

The change of density of Fe and steel as the result of cold-working and of tempering was investigated. The density of Armco Fe decreased 0.12% by cold-working of 77.6% reduction in area. In tempering this Fe, a maximum at 150° and a minimum at 400° were observable and at higher temperatures the density increases, till it resumes the value before rolling. The maximum is due to the stress-release and the minimum is to be attributed to the increase of stable internal stress at the cost of the unstable one during tempering. The increase of density at a higher temperature shows the recovery of the original state before rolling. Remelted Armco Fe did not show such a change of density. In the case of 0.1% C steel, the amount of the maximum and the minimum is less. Their magnitude diminishes with the increase of C content, being hardly traceable in 0.2% C steel. This means that it is difficult to remove the internal strain in steels in which hard cementite is present in a large amount. KT(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion Symposium a Feature of T. A. P. P. I. Meeting. *Chemical & Metallurgical Engineering*, Vol. 37, March 1930, pages 155–156.

Corrosion is particularly troublesome in sulphite mills. J. D. Miller, Chairman of the committee on corrosion problems of the Technical Association of the Pulp and Paper Industry, reported at the meeting held Feb. 17–20, 1930, that the average value of the corrosion loss was $98.75/year/ton daily production. This is based on answers to a questionnaire. Attention is being given to the ferrous alloys. Those of the 18–8 Cr-Ni type, with or without Mo, when properly prepared, are the best metals offered to date for resistance to sulphite corrosion. Andreas Christensen described the results obtained by him in a mill test of 2 alloys. The first was a steel containing 25–30% Cr, 1% Mn, 0.5% Ni, 0.5% Si, 0.25% C. The second belonged to the "18–8" group. Alloy No. 1 has given more than 2 years of continuous service without attack as parts of relief valves for a digester. Pipe made from No. 2 placed in a relief line next to the same digester has been in use for 15 months without wear. Because of these results, many small fittings and pipes are being changed from Cu and bronze to a ferrous alloy. The initial cost of the fittings made from these alloys is about twice that of bronze. Walter M. Mitchell stated that centrifugally cast Cr-Ni-Mo alloy tubing of large size is a commercial possibility in the near future. Fabrication of a full size digester of this alloy is a possibility. Riveting is to be preferred to welding as a means of construction. T. H. Nelson stated that an alloy with a residual Fe content of not more than 65% gives the most consistant results in respect to resistance to sulphite corrosion. The most suitable metal is one containing 20–25% Cr, 8–10% Ni, with the addition of Si or Mo. MS(4)

The Corrosion of Early Chinese Bronzes. WILLIAM F. COLLINS (Anglo-French China Corp. and S. Pearson and Son). *The Institute of Metals, Advance Copy* No. 548, 1931, 25 pages.

The probable mechanism of the formation of patina on early Chinese bronze is discussed in light of the corrosion studies made in England and the mechanism of mineral formation. Sulphur was probably not a factor in the corrosion of the Chinese bronzes. The ancient Chinese bronzes are unique in containing appreciable quantities of Pb. The analyses of a large number of these bronzes are given. The data also include the probable period of origin. Contains 30 references. JLG(4)

Protective Coatings for Aluminum and Alloys Present Problem. *Automotive Industries*, Vol. 62, Apr. 12, 1930, pages 583–584.

Abstract of a paper on "Some Recent Developments in Protective Coatings of Aluminum and Some of Its Alloys," by H. Sutton, presented at a meeting of the British Electroplaters' and Depositors' Technical Society. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 690. GN(4)

Chlorination Prevents Slime Fouling of Condensers. *Electrical World*, Vol. 96, Nov. 15, 1930, page 906.

Adhesion of slime to condenser tubes and the consequent decrease in the condenser vacuum and rate of heat transfer may be prevented by chlorination of the circulating water as proved by experiments conducted by the Northern Indiana Public Service Co. and by the Public Service Electric & Gas Co. The investigation brought out the following: (1) that slime adhesion to condenser tubes can be prevented by chlorination, (2) chlorination results in the depositing of a hard scale in the tubes which must be removed by cleaning by other means than rubber plugs, (3) when circulating water is treated with bleaching powder there is not so much scale deposited on the tubes as with the chlorine gas treatment, (4) chlorination does not cause corrosion or excessive loss in weight of condenser tubes, (5) uniform absolute pressure close to standard performance can be maintained with much less total cost for tube cleaning. A chart gives the performance of a condenser, the circulating water for which was treated alternately with Cl gas and bleaching powder in the East Chicago plant of the Northern Indiana Public Service Co. WHB(4)

Tests Yield Data for Applying Chrome Nickel Steels. *Machine Design*, Vol. 2, June 1930, pages 43–44.

Discussion of corrosion resistance under varying conditions and the machinability of KMI and KA2 with a chart showing comparative examples of resisting power of steels to corrosion. Tables give losses by exposure to dilute solutions and to air and water as well as losses by exposure to various chemicals. (4)

"Nimol" a New Corrosion Resisting Cast Iron. *Canadian Mining Journal*, Vol. 51, Dec. 12, 1930, page 1204.

This new alloy containing 75% ordinary cast iron, 4% chromium and 21% Monel metal has proved its usefulness in certain parts of marine steam boilers, as supports in metallurgical furnaces, and where resistance to sulphuric and hydrochloric acids is required. It is very useful in pumps of various kinds. WHB(4)

Corrosion of Tin and Its Alloys. C. L. MANTELL. *Sheet Metal Industries*, Vol. 3, Feb. 1930, page 596; June 1930, pages 168–170.

A paper before the American Institution of Mining and Metallurgical Engineers. Acetylene gas does not attack Sn. Carbon bisulphide tarnishes polished Sn surfaces. Many chlorinated and halogenated hydrocarbons corrode Sn. Formaldehyde, when oxidized to formic acid corrodes Sn. Sn or its alloys should not be used in any developing work because of a fog it creates in developed plates. Acid beer acquires turbidity in contact with Sn. Fresh milk does not affect Sn but sour milk corrodes it. In canned goods, chemical action will continue until Sn is dissolved entirely and then electrolytic action will be added because of the exposure of Sn and Fe in electrolyte. Discoloration is largely due to sulphides and sulphocompounds. Enamelled coatings over the Sn plate have been found to be not continuous so that chemical action is localized at points and is more rapid than if distributed over the entire surface of the can. AWM(4)

Corrosion Resisting Alloys for Pulp and Paper Mills. W. M. MITCHELL. *Paper Trade Journal*, Vol. 90, Feb. 20, 1930, pages 155, 156.

A paper presented at the Feb. 1930 meeting of the Technical Association of Pulp and Paper Industry. The selection of metals for the construction of plant equipment for use in handling corrosive materials in the problem affecting many processes and is always one of extreme importance. Corrosion phenomena and corrosion in paper mills are considered. The use of Ni bearing alloys such as 18/8 chrome nickel, KA2, Allegheny metal, 18/8/3 Cr-Ni-Mo, V4A, KA4 and Monel metal are discussed. (4)

The Resistance of Alloys to Sulfite Corrosion. J. D. MILLER. *Paper Trade Journal*, Vol. 90, June 6, 1930, pages 91–92.

A discussion of the preliminary results in sulphite digesters of Cr and Ni-Cr steels. (4)

Recent Developments in Embrittlement Research. F. G. STRAUB. *Power Plant Engineering*, Vol. 34, June 15, 1930, pages 686–687.

Sulphate prevents embrittlement only when it is present in amounts which will cause solid sodium sulphate to form in seams. Studies at pressures up to 1300 lbs. indicate that the present 3 to 1 ratio recommended by the A.S.M.E. code will be safe for practically all boiler pressures. The causes for boilers, which do not have sulphate ratios, not cracking is discussed. (4)

Corrosion of Aluminum Cast Alloys. (Ueber die Korrosion von Aluminium-Gusslegierungen.) R. STERNER-RAINER. *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 357–362; discussion; 17 references.

The writer tabulates in a clear fashion the corrosion resistance of pure Al, KS-Seewasser, Silumin, German Alloy, American Alloy and Navy Bronze against the attack of some 25 inorganic salt solutions and against a dozen various food stuffs as honey, lactic acid, mustard, whisky, etc. It is pointed out that all those elements which are suitable for separating Fe from Si, which impurities are always present, re-establish to a certain degree the corrosion stability of pure Al. Whether films are able to stop the starting corrosion could not definitely be settled although additions of Sb and Bi give some evidence in this regard. All the other additions, particularly Cu, are only liable to decrease the corrosion resistance of pure Al. The nature of atmospheric corrosion and of natural waters is considered and the favorable behavior of Silumin and KS-Seewasser mentioned. Stress is laid on the fact that even Cu-alloys can often be replaced by Al-cast-alloys. The corrosion resistance may be furthermore improved by paints, tars, varnish and similar coatings. The paper was presented at the Berlin Meeting of the Deutsche Gesellschaft für Metallkunde, March 1930. EF(4)

Salt Spray Corrosion Tests on Electrically Deposited Zinc-Cadmium Alloys. LAWRENCE E. STOUT & CHARLES L. FAUST (Washington Univ., St. Louis). *Metal Industry*, N. Y., Vol. 28, Aug. 1930, pages 381–383.

Results show that same Zn-Cd alloys electrically deposited on Fe from alkali cyanide solutions are superior to electrically deposited Cd as protection against rusting. Increase in resistance to corrosion is obtained when alloy contains as little as 0.5% of Zn and is constant until Cd is increased to 80%. Below this Cd concentration alloys become poorer as rust proofing agents. Alloys with 60% Cd and the rest Zn offer rust protection nearly equal to that offered by Cd. Zn-Cd alloys display superior adhesion to base metal than either Zn or Cd alone. Zn-Cd alloys can easily be buffed to luster and clear bluish metallic color. VSP(4)

Rust Resistance of Iron and Steel Sheets. W. H. MELANEY. *Heat Treating & Forging*, Vol. 16, July 1930, pages 887–888; *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1471–1472.

Describes manufacture of wrought Fe by the puddling process, the purpose being to show that wrought Fe is superior to steel with respect to corrosion resistance because of the coating of slag about the particles of Fe. MS(4)

On the Passifying Effect of Red Lead. (Ueber die passivierende Wirkung der Bleimennige.) E. MAASS & E. LIEBRIECH. *Korrosion und Metallschutz*, Vol. 6, Aug. 1930, pages 178–181.

On the strength of their experiments and based on theoretical considerations the authors doubt the passifying effect of minium by loading the surface of Fe with oxygen and are inclined to believe that the protection is merely due to the alkaline character of lead oxide. The formation of lead soap is supposed to affect physical properties of surface film. EF(4)

Applying Protective Coatings on Metal. H. SUTTON. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 43–44.

From paper read before Electroplaters' & Depositors' Technical Society. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 690. MS(4)

The Local Current Theory of Corrosion and Passivity. (Zur Lokalstromtheorie der Korrosion und Passivität.) F. TOEDT. *Zeitschrift für physikalische Chemie*, Vol. 148, June 1930, Abt. A, pages 434–440.

Corrosion in weak acid, weak alkali or neutral solutions is dependent upon local currents whose size depends on the depolarization of O_2 at the cathode. The significance of local action between the metal and its oxide coating is discussed with relation to passivity and its periodic occurrence. (4)

The Corrosion of Lead and Its Significance in the General Interpretation of Corrosion. (Die Korrosion des Bleis und ihre Bedeutung für die allgemeine Erkenntnis der Korrosion.) M. WERNER (I. G. Farbenindustrie). *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 342–347.

Grain size plays the same role in Pb corrosion as in all metals and alloys. The addition of other metals is only liable to improve the corrosion resistance if passification takes place. However, the occurrence of a eutectic in the system Pb–impurity upsets the favorable influence of the addition. Cold work does not affect the corrosion stability of Pb because of the great recrystallization velocities met at even ordinary temperatures. The best grade of corrosion proof Pb contains no O. The lack of proper methods of testing, complicating the interpretation of Pb corrosion, is pointed out and the application of new methods urged. The paper was presented before the Deutsche Gesellschaft für Metallkunde, Berlin 1930 and includes a long discussion. EF(4)

The Open-Air Corrosion of Copper. Part II. The Mineralogical Relationships of Corrosion Products. W. H. J. VERNON & L. WHITBY. *Engineering*, Vol. 130, Nov. 14, 1930, pages 631–632.

Condensed from paper read before the Institute of Metals, Southampton, Sept. 11, 1930, *Metals & Alloys*, Vol. 1, Nov. 1930, page 843. LFM(4)

Corrosion of Different Types of Corrosion Resistant Steels by Common Acids. (Attaque de divers types d'acier inoxydables par les principaux acides usuels.) M. SAUVAGEOT & L. LAUPRETE. *Revue de Metallurgie*, Vol. 27, July 1930, pages 362–367; *Chimie et Industrie*, Vol. 23, Mar. 1930 (Special issue), pages 227–231.

Short time (not over 5 hrs.) corrosion tests were made on corrosion resisting steels of the following types: 13% Cr, 8% Ni-20% Cr, 8% Ni-19% Cr, and 32% Ni. Temperature used was 15° and 80° C. with acid concentrations up to 65%. All steels were annealed. High Cr and Ni-Cr steels are very resistant to HNO_3. In HCl and H_2SO_4, they dissolve at the ratio depending on acid concentration, with almost the same speed as common steels. The superiority of Ni-Cr over the Cr type is observed only at low acid concentration. High Ni steel resists H_2SO_4 and HCl better than all the others but is rapidly attacked by HNO_3. JDG(4)

Heat Enduring Metals for Furnace Construction. B. J. SAYLES (Calorizing Co.). *Fuels & Furnaces*, Vol. 8, May 1930, pages 699–701; June 1930, pages 835–838, 844–845, 864.

Commercially available heat enduring materials include Cr plated mild steel, calorized mild steel, and the following alloys: (a) 60% Ni, 20% Cr, 20% Fe; (b) 35% Ni, 15% Cr, 50% Fe; (c) 8% Ni, 20% Cr, 72% Fe; (d) 8% Ni, 30% Cr, 62% Fe; and (e) 18% Cr, 82% Fe. Cr plating has several disadvantages—the porosity of the deposit, and the difference in coefficient of expansion of the Cr film and of the steel. The Fe-Al alloy formed in calorizing is immune to oxidation up to 1650° F. Tubular materials are treated by the powder method, while irregularly shaped articles are processed by the dip method. It is customary to fabricate parts before calorizing, as doing so after treatment injures the alloy surface. It is not feasible to weld calorized parts. In the case of the ferrous alloys listed, the content of C and other elements is very important in determining the useful life of the alloys. Cites W. H. Hatfield's results of oxidation tests in various atmospheres and at various temperatures (*Journal of the Iron & Steel Institute*, Vol. 115, 1927, pages 483–508). These indicate that the usefulness of a 13% Cr-87% Fe extends to about 1650° F., while an alloy of the (c) type might be used slightly beyond that temperature. A test carried out in a H_2S atmosphere at 1200° F. showed that resistance to S corrosion increased with increase in Cr content. Calite "B" has a maximum safe working temperature of 1800° F., and the safe load at this temperature is 2000 lbs./in.^{2} Its coefficient of linear expansion is 0.000005° F., sp. gr., 7.49; thermal conductivity, 5.5 B.t.u./hr./ft.^{2}/ft. thickness/° F.; Brinell hardness, 340. Discusses design of heat enduring structures. MS(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Constitution of the Cadmium-Rich Alloys of the System Cadmium–Silver. P. J. DURRANT (Selwyn College, Cambridge). *The Institute of Metals, Advance Copy* No. 549, 1931, 15 pages.

Alloys containing up to 40% Ag were studied microscopically and by means of heating and cooling curves. There are 3 peritectic lines, and 3 solid solutions in this area. The solid solubility of Ag in Cd is 6.0% at 343° C., and 5.2% at 250° C. The second solid solution includes from 18 to 33.5% Ag, the third more than 36% Ag. Contains 6 references. JLG(5a)

Martensite. (Ueber den Martensit.) *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1780–1782.

Correspondence on the nature of martensite between H. Hannemann and S. Steinberg. GN(5a)

Metallography of Zinc Base-Die-Casting Alloys. W. M. PEIRCE. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 1, 1930, page 334.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. (5a)

Practical Application of the Sulphur Prints of R. Baumann. (Praktische Anwendung des Schwefeldruckes von R. Baumann.) HUGO PATSCH. *Giesserei*, Vol. 17, Aug. 29, 1930, pages 853–854.

The sulphur print method of Baumann is used for making prints of chilled and gray Fe casting surfaces containing fine cracks. Repeatedly printing the same spot gives prints which are progressively weaker. By moistening the cracked surface with dilute H_2SO_4 and using AgBr-paper which has been soaked in 5% H_2SO_4 a sharp, dark print is again obtained. (5a)

Investigations of the Mechanism of the Solution of Cementite in Carbon Steel and the Influence of the Heterogeneity of the Material. (Undersökning rörande mekanismen vid cementitens lösning hos kolstal samt inflytandet härpa av heterogeniteten hos materialet.) ERIK WALLDOW. *Jernkontorets Annaler*, Vol. 114, Nov. 1930, pages 377–430.

Contains 16 references. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 4. HCD(5a)

The Equilibrium Diagram Iron-Vanadium (Zur Kenntnis des Zweistoffsystems Eisen-Vanadin.) F. WEVER & W. JELLINGHAUS. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 164, pages 317–322; *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, page 1788.

The equilibrium diagram Fe-V was newly established by thermic-microscopic, magnetometric and X-ray investigations. The crystallization starts with the formation of cubic space centered α-solid solutions, the parameter of which increases with the V content. The field of the cubic face centered γ-solid solution is closed and extends up to 1.1% V. The solid solution with 48% V transforms to the compound FeV at 1234° C., as revealed by thermic, microscopic and X-ray examination. This compound dissolves Fe as well as V in excess. The Curie point of Fe is raised first, but essentially lowered with higher contents of vanadium. GN(5a)

Structures of Solid Solutions of Iron with Beryllium and Aluminum. (Ueber den Aufbau der Mischkristalle des Eisens mit Beryllium und Aluminium.) F. WEVER & A. MÜLLER. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 193, Oct. 4, 1930, pages 337–345.

Thermal and microscopic study of Fe-Be and Fe-Al alloys led to a new determination of the Fe side of the equilibrium diagram. Both systems have completely closed γ-fields. Solid solutions of α-Fe with Be and Al are formed by atomic substitution; the same structure is assumed for the solid solutions of γ-Fe with both elements. The unusual behavior of C in alloy formation with Fe has no parallel in the elements Be and Al. (5a)

The Course of Reactions Between Graphite and Oxides as Well as Between Heavy Metal Carbides and Oxides. (Ueber den Verlauf der Reaktionen zwischen Graphit und Oxyden sowie zwischen Schwermetallkarbiden und Oxyden.) O. MEYER. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 193–198. *Stahl und Eisen*, Vol. 50, Nov. 13, 1930, page 1619.

The investigation was undertaken to determine the stability of materials of crucibles of various mixtures of carbides and oxides which was done by measuring the pressure of reaction. The systems graphite–silica, graphite–MnO, graphite–alumina and graphite–silica–iron were examined. Crucibles of the above mixtures were heated in a C spiral-vacuum furnace, the CO pressure was measured and plotted in diagrams against the temperature. The oxides of Mn, Si and Al easily evaporate, thus leading to wrong values of the pressure. MnO, SiO_2 and also Al_2O_3 are reduced at temperatures above 1550° C. Powdered carbides and oxides react at temperatures where the compact crucibles do not yet show any reaction. Mo_2C, W_2C, WC and SiC show weaker reactious with oxides than graphite. Mixtures of chromium and tungsten carbides, which are rather resistant to O, do not show the same resistivity to oxides. Titanium nitride reacts strongly with oxides. GN(5a)

A Thermodynamic Study of the Phasial Equilibria in the System Iron-Carbon. CHU-PHAY YAP. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 381, 1931, 26 pages.

The Fe-C diagrams determined by several investigators have been replotted, using instead of weight % C, molal concentration of C and Fe_3C. The topography of these diagrams indicate that just before the liquid transforms to δ Fe, C exists in solution as the element, while in liquid Fe containing a larger amount of C it exists as the carbide Fe_3C. Upon solidification, the Fe_3C decomposes to yield a solution of elementary C in γ-Fe. The liquidus of Ruer and Goerens, and a solidus drawn as a straight line from 0.18% C at the peritectic temperature to about 1.7% at the eutectic temperature probably represents the real equilibria based on the diagrams as replotted and application of the available thermodynamic data. The solidus determined by Honda and others by heating, probably does not indicate the same line as determined by cooling from the liquid condition. A thermodynamic analysis indicates the heat of fusion of pure Fe as about 64 cal./g., which is in agreement with recently determined values and not with the values of 48 and 49.4 given in the International Critical Tables. The heat of transformation of γ to δ-Fe is calculated as about 2 cal./g. Contains 21 references. JLG(5a)

Influence of Dissolved Carbide on the Equilibria of the System Iron-Carbon. CHU-PHAY YAP. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 382, 1931, 19 pages.

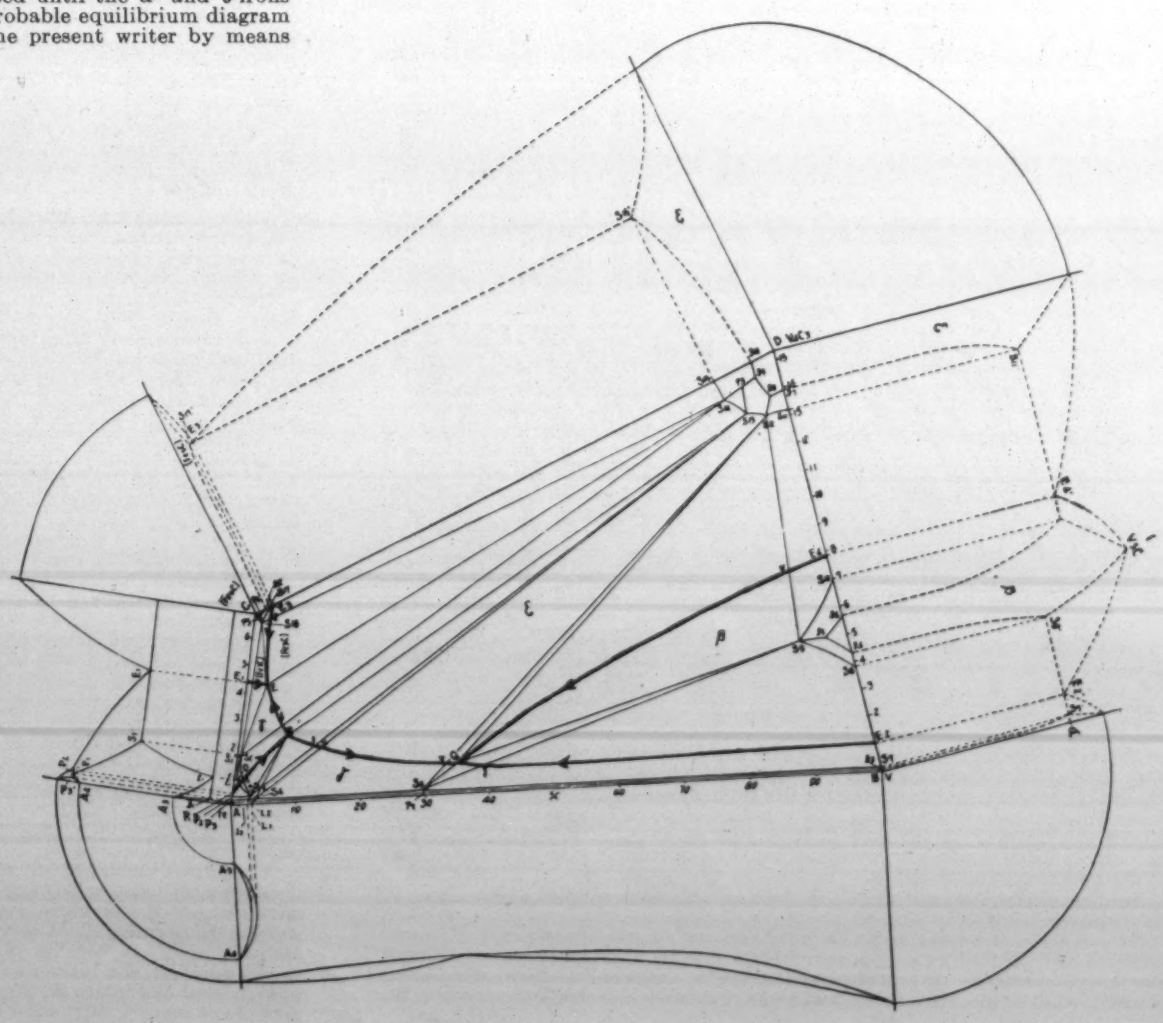
In a previous paper (*Technical Publication* No. 381) the author showed by thermodynamics that the solidus in the Fe–C system should be a straight line, as found by English investigators. Others have found a curved solidus. The straight line has usually been found by cooling from the molten condition while the curved line has been found on heating. Honda and Endo determined the solidus by susceptibility measurements. Their data are replotted on a larger scale and, from the course of the curves, it is concluded that the indicated melting point is too low because the Fe_3C has not been decomposed. It is concluded that when an Fe-C alloy is heated from room temperature, as austenite is formed the Fe_3C dissolves to form a solution of Fe_3C in γ-iron, and, dependent on the rate of heating and other factors, part of the Fe_3C decomposes to give a solution of C in γ-iron. The amount of dissociation of Fe_3C influences the temperature at which melting begins. As the alloys are cooled from the melt the C is in solution in the γ-iron as elementary C. With a given C percentage the alloy containing undecomposed Fe_3C in solution will have the lower melting point. Contains 14 references. JLG(5a)

On the Equilibrium Diagram of the Iron–Vanadium–Carbon System. S. OYA. *Kinzoku no Kenkyu*, Nov. 1930, pages 615–634; *Science Report of the Tohoku Imperial University*, Series I, Vol. 19, 1930, pages 449–472.

Vogel and Tammann's diagrams of V–Fe system were combined and utilized. Fe and V form a continuous series of solid solutions. The A_4 point of Fe is lowered and the A_3 point is raised until the α- and δ-irons unite at about 2.5% V, forming a loop. The probable equilibrium diagram of V–C system was obtained by Osawa and the present writer by means of X-ray analysis and microscopic investigation. There exist 2 carbide phases β and ϵ, consisting mainly of compounds V_8C and V_4C_3, respectively. α-Phase consists of V dissolving C. By thermal analysis, liquidus surface, binary eutectic curves E_1E, E_2P, E P, peritecto-eutectic point P, ternary eutectic point E were determined. By X-ray analysis it was found that the ϵ-phase with the face-centered cubic lattice is present in high C alloys; the β-phase with hexagonal close packed lattice is present in low C alloys; and α-phase with body-centered cubic lattice is present in high V and low C alloys. The microscopic investigation was also applied mainly to high C and high V alloys. The ϵ- and β-phases can be seen distinctly without etching; the primary ϵ-phase reveals the globular dendrite, while the primary β-phase crystallizes in the columnar form. The β-phase is not colored by boiling sodium picrate, but the ϵ-phase is colored slightly by long heating. By etching with the picric acid, the β is not changed in color, though the crystal boundaries are clearly revealed; the ϵ is also hardly etched, but colored slightly bluish gray after long etching. The equilibrium diagram of Fe–V–C system thus obtained is shown in the figure, from which the following facts are deduced. (1) No ternary compound exists in this system but 5 liquidus surfaces for the γ, α, Fe_3C, ϵ and β phases exist. (2) The following binary eutectic and peritectic reactions exist in this system: melt $\longrightarrow \gamma + Fe_3C$, melt $\longrightarrow \gamma + \epsilon$, melt $\longrightarrow Fe_3C + \epsilon$, melt $\longrightarrow \alpha + \epsilon$, melt $\longrightarrow \epsilon + \beta$, melt $\longrightarrow \alpha + \beta$ and δ + melt $\longrightarrow \gamma$. (3) In this system, the following 2 ternary eutectic reactions and also a peritecto-eutectic reaction take place: (1) melt $\longrightarrow \gamma + Fe_3C + \epsilon$, (2) melt $\longrightarrow \alpha + \beta + \epsilon$, (3) δ + melt $\longrightarrow \gamma + \epsilon$. The composition and temperature of these non-variant points are as follows:

(1)	3.4% V	4.2% C	1122°
(2)	about 35.0% V	1.0% C	....
(3)	7.0% V	2.3% C	1330°

(4) In the region of the γ-phase, there exist 3 solubility surfaces, in which α, ϵ and Fe_3C begin to separate respectively, and 3 binary eutectoid curves along which the reactions $\gamma \longrightarrow \alpha + \epsilon$, $\gamma \longrightarrow \alpha + Fe_3C$ and $\gamma \longrightarrow Fe_3C + \epsilon$ take place. KT(5a)

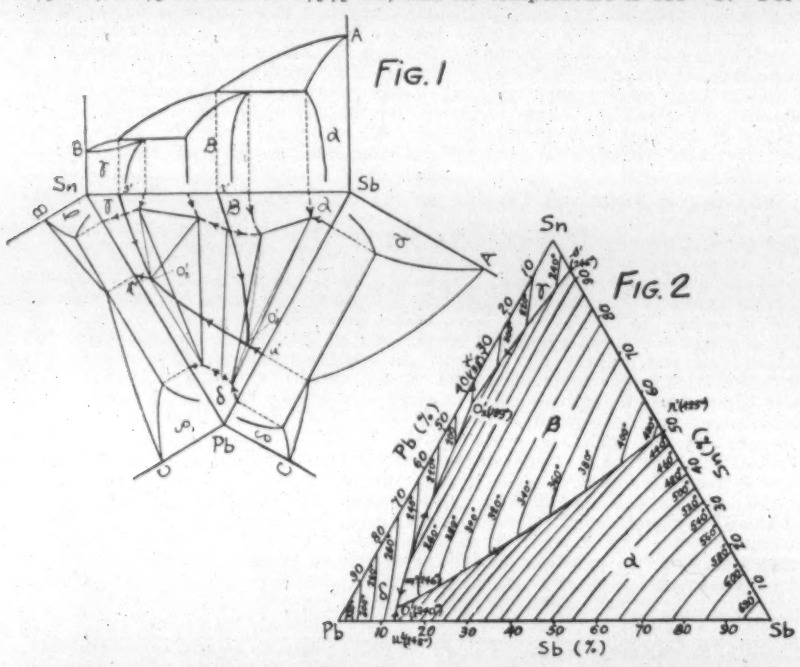


The Question of the Origin of Meteorites. (Zur Frage des Ursprungs der Meteorite.) WILLIAM D. URRY & W. KOECK. *Zeitschrift für Elektrochemie und angewandte physikalische Chemie*, Vol. 36, Sept. 1930, pages 727–732.

The question of the origin and age of meteorites is discussed by the authors in the light of experiments on the helium and radium contents of a number of meteorites. They conclude that meteorites are of the same origin as the planets, having sprung from the mixture of which the sun consists. The oldest meteorites that have remained unchanged are contemporaneous with the earth. OWE(5a)

An Investigation of Type-Metals. Part 4. On the Equilibrium Diagram of the Lead–Antimony–Tin System. NOBUTOSHI AOKI & SHOJIRO WAKI. *Naikaku Insatsu-kyoku Kenkyujo Chosa Hokoku (The Report of the Research Laboratory, Government Printing Bureau, Japan)*, No. 21, Nov. 1930, pages 1–36.

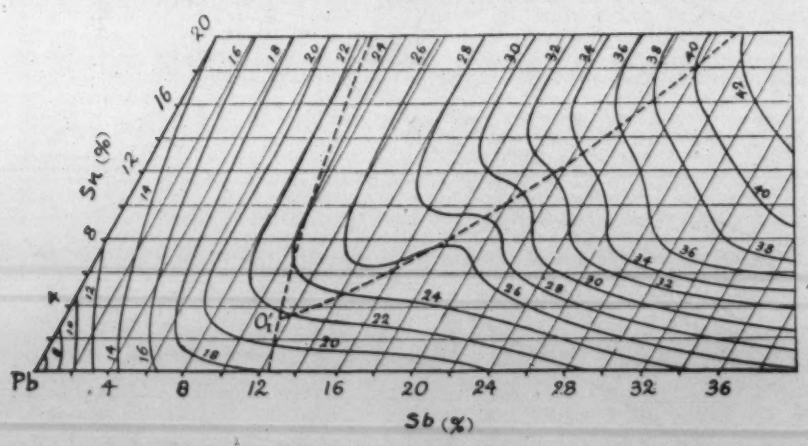
The primary crystallization points and the transformation points for about 200 alloys of the Pb–Sb–Sn system were determined by means of thermal and microscopic analyses, and the solidus, by differential thermal analysis. From the results thus obtained, 13 sectional diagrams of the system were constructed, and from these diagrams the space model of this ternary system was also constructed. Fig. 1 shows a diagram obtained by projecting the space curves in this model onto the base of a triangular prism. As we see in the diagram, this system contains 4 liquidus surfaces from which α-, β-, γ- and δ-ternary solid solutions separate from the homogeneous melt. Along the boundary curves $r'o'_1$, and $s'o'_2$ peritectic reactions take place. Along the boundary curves u',o'_1, o'_1,o'_2 and o'_2t' binary eutectic reactions take place. Hence, points, o_1 and o_2, correspond to a ternary eutectic point and a peritecto-eutectic point respectively. The former point lies on the composition, 85% Pb, 11.5% Sb and 3.5% Sn, and its temperature is 240° C., and the latter point lies on the composition, 40% Pb, 2.5% Sb and 57.5%% Sn, and its temperature is 189° C. For



determining the points, O_1 and O_2, the microstructures of 156 specimens containing various compositions were observed after being heated for 50–500 hours, in several temperatures and quenched in water. Fig. 2 shows the isothermal curves surfaces. The authors have also constructed the more detailed curves for the composition range of actual type-metals such as 50–100% Pb, 0–30% Sb and 0–20% Sn. TS(5a)

An Investigation of Type-Metals. Part 5. On the Brinell-Hardness of the Lead–Antimony–Tin Alloys. NOBUTOSHI AOKI & SHOJIRO WAKI. *Naikaku Insatsu-kyoku Kenkyujo Chosa Hokoku (Report of Research Laboratory, Government Printing Bureau, Japan)*, No. 21, Nov. 1930, pages 47–62.

Fourteen specimens each of Pb-Sb and of Pb-Sn alloys containing various compositions and 12 specimens of Sb-Sn alloys were prepared by casting in a metallic mold from temperatures 100° to 200° C. above the melting point of each alloy, and finished to the size of 20 × 20 × 30 mm. with emery paper. The Brinell hardness of each alloy was determined, and the hardness-composition curves of each series were drawn. From these curves, we can see that in the Pb-Sb alloys the hardness ascends as the Sb content increases,



while in Pb-Sn alloys 2 maximum points are observable at 64% Sn and 70% Sb. Brinell hardness was also determined for 82 ternary alloys of the Pb–Sb–Sn system, and from the results thus obtained the isohardness curves were constructed in the composition range of actual type-metals, such as 50–100% Pb, 0–30% Sb and 0–20% Sn, as shown in the figure. The change in hardness due to composition was attributed to the separation of new phases in each alloy. TS(5a)

Sulphur Print Tests. L. E. BENSON. *Electrician*, Vol. 106, Jan. 2, 1931, pages 4–5.

The value of the sulphur print test, and its simple operation and sensitiveness are pointed out. Sulphur prints can be applied to practically all the usual steels of engineering importance. Steels of high chromium content, such as stainless steels and some non-magnetic steels are exceptions. WHB(5a)

Structure & X-ray Analysis (5b)

Texture of Metals after Cold Deformation. FRANZ WEVER (Kaiser-Wilhelm-Institut für Eisenforschung). *Preprint, American Institute of Mining & Metallurgical Engineers*, 1931, 25 pages.

A method is described for the determination and description of the orientation of the crystallites in deformed metals: Representation is by means of "pole figures." In cold-rolled face-centered metals the 111 direction lies in the direction of rolling, and the 011 direction in the cross direction. In iron, body-centered cubic, the direction of rolling and the cross direction are indexed 011, and the (001) plane is parallel to the surface of the foil. The formation of texture by drawing, cylindrical compression, rolling, and plane parallel deformation is analyzed. Warpage of the planes of the crystals is a factor in hardening during cold working. Contains 39 references. JLG(5b)

Alloys of Zinc and Manganese. (Le leghe di zinco e manganese.) N. PARRAVANO & V. MONTORO. *La Metallurgia Italiana*, Vol. 22, Dec. 1930, pages 1043–1051.

X-ray studies on 14 Zn-Mn alloys showed, under 1% Mn, a hexagonal solid solution (η) of Mn in Zn. The saturated η has a lattice constant of 2.67 A. U. and an axial ratio of 1.85. In an alloy of 1.9% Mn, the ε phase was detectable. ε is taken to be $MnZn_7$ (10.73% Mn), it has a hexagonal structure, a lattice constant of 5.634 A. U., and an axial ratio of 1.58. Although ε is considered to be a definite compound, alloys ranging from 8.6 to 11.9% Mn are tabulated as showing only the ε phase, with the same constant and axial ratio. η plus ε appeared between 1.9 and 8.1% Mn. Between 12.2 and 20.7% Mn, η plus γ were present. γ is considered to be $MnZn_3$, body centered cubic, with a lattice constant of 9.195 A. U. The unit cells of the 2 compounds are taken as made up of 16 atoms (2 $MnZn_7$) and 48 atoms (12 $MnZn_3$), respectively. HWG(5b)

Examining Metals by Means of X-Rays. (Metalltechnische Röntgenuntersuchung. Neuere Forschungsergebnisse.) A. HERR. *Giesserei Zeitung*, Vol. 27, Nov. 1, 1930, pages 590–598.

The possibilities of detecting failures in casting by means of X-rays is considered from the standpoint of the recent development. GN(5b)

Constitution of High-purity Aluminum-titanium Alloys. WILLIAM L. FINK, KENT R. VAN HORN & P. M. BUDGE (Aluminum Co. of America). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 393, 1931, 18 pages.

The liquidus and solidus in the Al rich Al-Ti alloys were determined. The liquidus rises rapidly with the Ti content, beginning at about 0.2% Ti. There is practically no solid solubility of Ti in Al. A compound $TiAl_3$ is formed. A complete X-ray analysis of this compound is given. It is tetragonal with a = 5.45 and c = 8.60 A. U. Contains 9 references. JLG(5b)

Quantitative Analysis by X-Ray Spectroscopy. C. E. EDDY & T. H. LABY. *Proceedings Royal Society*, London, Vol. 127, Series A, Apr. 1, 1930, pages 20–42.

Includes a description of the quantitative analysis of alloys of elements of nearly equal atomic numbers by means of X-rays. The intensities of analogous spectral lines on photographic films were measured photometrically and the percentage compounds of the alloys calculated with an accuracy of about 1 in 200. Cu-Zn, Sn-Cd, Pb-Be and Sn-Zn alloys were investigated and good results obtained except for the Sn-Zn alloys where the atomic numbers differ greatly. Heterogeneity of the alloy when used as the X-ray tube target has very little effect upon the results. (5b)

X-Ray Investigation of Metals in the U. S. S. R. E. F. BACHMETEW. *Metals & Alloys*, Vol. 1, Nov. 1930, pages 828–830.

A brief résumé of the activities of the various organizations of the U. S. S. R. in the field of radiography. ESC(5b)

An X-Ray Study of the A_3 Point of Iron and Some Iron-Nickel Alloys. OSCAR L. ROBERTS & WHEELER P. DAVEY. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 648–654.

The transition temperature at which the body-centered cubic structure of very pure Fe changes to the face-centered cubic structure is found to occur reversibly at a temperature between 907 ± 3° C. and 910 ± 3° C. The Ac_3 points for alloys of Fe and Ni containing 1.04, 2.78, 4.27, 11.73, 13.21% Ni are found to lie between the limits, respectively, 820–815° C., 720–715° C., 660–655° C., 525–520° C., 520–515° C. The Ac_3 and Ar_3 points do not coincide. The fractional lowering of the Ac_3 point is greater for the first 10% Ni than it is for the larger percentages. Spectroscopic analysis of the alloy used is included. Technique of preparation of specimens, apparatus used, and procedure of observations are described in detail. ESC(5b)

Lattice Distortion as a Factor in the Hardening of Metals. W. L. FINK & K. R. VAN HORN. *Engineering*, Vol. 130, Sept. 19, 1930, page 358.

Abstract of paper read before the Institute of Metals, Sept. 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. LFM(5b)

X-ray Studies of Gold Copper Alloys. (Röntgenuntersuchungen an der Legierung AuCu.) K. OHSHIMA & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 129–135; *Zeitschrift für Physik*, Vol. 63, July 14, 1930, pages 210–223.

Cu and Au form, at high temperatures, a continuous series of solid solutions. Below 400° the solid solution decomposes, over a wide range of concentrations with the formation of AuCu and $AuCu_3$. AuCu has a tetragonal face centered, and $AuCu_3$ a cubic face centered structure. By quenching from above the transformation temperature, followed by aging, age-hardening heat treatment is possible. This seems to be due to AuCu, not to $AuCu_3$. The behavior in respect to AuCu is somewhat similar to the α-γ inversion in iron. The cubic phase in the alloy corresponding to the composition AuCu has a lattice constant of about 3.86 A. U. The tetragonal phase has the constants a = 3.95 and c = 3.68 A. U., the a:c ratio being 1.072. The change of cubic to tetragonal is shown by the following table:

Treatment	Ratio a:c
Very slowly brought to 500° C. and cooled	1.07_4
Quenched from 600° C.	1.00_4
Quenched and drawn at 200° C. for 1/2 hr.	1.00_8
Quenched and drawn at 200° C. for 2 1/2 hrs.	1.01_7
Quenched and drawn at 200° C. for 7 1/2 hrs.	1.02_4
Quenched and drawn at 250° C. for 1/6 hrs.	1.04_4
Quenched and drawn at 250° C. for 2/3 hr.	1.05_7
Quenched and drawn at 250° C. for 1 2/3 hrs.	1.04_3
Quenched and drawn at 250° C. for 3 2/3 hrs.	1.07_6
Quenched and drawn at 250° C. for 8 2/3 hrs.	1.06_7

X-ray photograms are shown. HWG(5b)

X-Ray Examination of Commercial Galvanized Iron by a Modified Reflection Method. CHARLES W. STILLWELL & GEORGE L. CLARK. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, pages 266–272.

A modified technic for obtaining diffraction patterns by reflection is described, the method being used particularly for metals and alloys. The composition of the various phases is given for galvanized iron wire, and galvanized Armco sheet steel. A complete description of zinc and other metallic coatings can be obtained only by coöperative microscopic and X-ray analysis, the former to give a picture of the distribution of the several phases, and the latter to determine the state of combination of the metals in these phases. Diffraction patterns are shown. MEH(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Tensile Forces in Stranded Cables. (Die Dehnungsarbeit an Seilen.) J. GROEBL. *Elektrotechnische Zeitschrift*, Vol. 51, Dec. 4, 1930, pages 1669–1673, 1687, 1713–1716.

It has been observed that stranded cables as used in electrical transmission lines gave way at 50% of their calculated tensile strength and broke at the suspension point where it could be clearly seen that a torsion must have been the cause. The author shows that in such ropes under load, torques are developed in the layers of strands which in the usual construction of a cable do not compensate one another completely but that a differential torque remains which increases proportionally with the load of the cable. These torques cause a torsion in the cable in such a manner that one layer of strands is turned still further in the direction in which it is wound, and the other layer in the opposite direction, is made looser; the former layer is therefore stressed more than normal, the other less. Thereby the proportional elastic limit may easily be exceeded so that fracture results at the place of suspension where the cable is clamped and can not follow the torsion. These conditions are theoretically investigated, the torsion curve derived, and the apparent elastic modulus calculated both for cables clamped on one end and on both sides. Finally, a cable construction is developed from these reasonings in which the torques in the individual layers of strands balance one another. For cables with 3 layers for instance this is done by winding the 2 inner layers in the same direction and the outer layer in the opposite. To obtain absolute equilibrium of the torsional moments the section of the outer strand and its individual wires is, further, reduced so much as to make the torsion in this layer exactly alike and of opposite direction to the torsion of the 2 inner layers. The tests made with a cable built up in this way shows it to be absolutely free of torsion, with an absolutely uniform distribution of load over the whole section. Ha(6)

Vibration Tests on Steam Turbine Nozzles in Order to Determine the Quality of the Riveted Joints between Nozzles and Peripheral Holding Bands. (Schwingungsversuche an Dampfturbinenschaufeln zur zahlenmässiger Bestimmung des Gutegrades der Nietverbindung zwischen Schaufeln und Deckbändern.) G. KIRCHBERG. *Forschung und Technik*, 1930, pages 478–489.

A special test arrangement is described with which the frequencies of vibration of steam turbine nozzles and bundles of nozzles can be determined and compared with calculated values. From the tests, it is concluded that the quality of the joint between nozzles and band is of a constant value and does not depend on the dimensions of the nozzles. The theory of the calculation is given and numerous oscillograms illustrate the process. Ha(6)

Some Results of Fatigue Tests of Metals. A. ONO. *Journal Society Mechanical Engineers*, Tokyo, Vol. 2, Aug. 1929, pages 331–341.

Two different kinds of repeated stress experiments were made; one refers to cast Fe, in which fatigue resistance under repeated tensile stress was compared with that under repeated bending stress. The other experiment refers to fatigue resistance of steel under repeated bending stress applied with or without simultaneous action of steady torsional stress. These experiments show that the stress at a particular point of material cannot be taken as a criterion of strength. The nature of fatigue failure is briefly discussed to elucidate the results of the experiments. (6)

Michrocharacter Hardness Tester Avoids Core Effects. *Iron Age*, Vol. 126, Oct. 23, 1930, page 1143.

Abstract of paper read before the American Society for Steel Treating by C. H. Bierbaum of Lumen Bearing Co. VSP(6)

Notched-Bar Impact Tests—Standard Test Piece. (Kerbschlagproben—Normenprobe.) M. MOSER (Fr. Krupp, Essen, Germany). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 222–224.

Lists various sizes of Charpy bars and shapes of notches now under discussion. HWG(6)

Some Results of Laboratory Tests and of Practical Experience with Rails on Swiss Railways. (Einige Ergebnisse der Laboratoriumsversuche und der Betriebserfahrungen mit Eisenbahnschienen in der Schweiz.) P. LUCCHINI (Swiss Railways) & M. ROS (Materialprüfungsanstalt, Zürich) *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 190–212. 24 illustrations.

Wear tests are made on the Amsler machine with 4 cm. diameter discs, 1 cm. wide, upper disc at 200 r. p. m. lower at 180, pressure 40 kg. From the slip between the discs, the pressure, the dimensions of the discs and the total work as shown by the integrator on the Amsler machine, a friction index is calculated. This index multiplied by the pressure and divided by the loss in grams of the specimen for the last 100,000 revolutions is taken as a measure of wear-resistance. The 40 g. pressure used is figured as best representing the pressure between rail and wheel. The speed is slower, but the slip is greater than in rail service. Heat-treated rails of around 300 Brinell show much better wear resistance both in Amsler tests and in the track, than ordinary Swiss rails of 150–205 Brinell. Some heat-treated rails with the surface of the head sorbitic, and some with it martensitic were put in service in 1928. Details of results are promised for the 1931 meeting. HWG(6)

An Account of Investigations on Wear in the Amsler Machine. (Redogörelse för nötningsunders ökingar i Amslermaskin.) C. J. GUNNAR MALMBERG. *Jernkontorets Annaler*, Vol. 114, Nov. 1930, pages 572–592.

The paper gives an account of the investigations which have been carried out on ring material for trolleys and railway coaches in an effort to standardize the tests. The Amsler machine tests wearing resistance by grinding 2 cylinders against each other at pressures up to 200 kg. The cylinders may both be rotated clockwise (positive slippage) or one counterclockwise (negative slippage). In either case the roll moving with the lowest r. p. m. is considered the test piece. Aside from the quality of the material, the amount of wear is shown to be dependent on (1) the total load (2) the local strains, (3) the slippage and (4) the wear distance. It is shown that standardization requires fixation of load (P), diameter (D), r. p. m. (n) and the time (T). In the actual runs, the test cylinders (60 mm. diam.) were turned of wrought iron, while the whetting cylinders (60–55 mm. diam.) were punched from rolled rods which were not heat treated after the rolling. With regard to the diameter of the rolls it was found that there was essentially no influence between 35 and 50 mm., with 10% positive slippage, but the wear was only about 25% as great for 50 mm. as for 35 mm. with 170% negative slippage. Increasing the % C from 0.6% to 0.8% quadrupled the wear but the minimum wear was with 0.90%. The wear also increases with the slippage. Wear on the test cylinder and the whetting cylinder tends to run parallel. The wear decreases with increased Brinell hardness, and the total wear is a minimum when the hardness of the test cylinder exceeds that of the other cylinder. Oil hardened test cylinders wore down the whetting cylinder much more than did water hardened test cylinders. It is felt that the structure plays a large part in wearing resistance. The author concludes that no great difficulty should be encountered in standardizing dimensions of the test piece, load, slippage, r. p. m. and duration of test. (Five references.) HCD(6)

A Comparison of the Physical Properties of Various Kinds of Cast Iron Pipe. F. N. MENEFEE & A. E. WHITE (University of Michigan). *Journal American Water Works Association*, Vol. 22, June 1930, pages 796–836.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 795. (6)

Physical and Chemical Properties of the Light Metals. Mechanical Testing of Aluminum Alloys. A. VON ZEERLEDER (Aluminum Industrie A. G., Switzerland). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 257–272.

Compilation of the properties of Al, Mg and most of their industrially important alloys. Preferred test bar sizes and test methods are shown and commented upon. HWG(6)

Strain Hardening of Lead, Tin, Cadmium and Zinc at Different Temperatures. (Etude sur l'ecrouissage du plomb, de l'etain, du cadmium et du zinc, a differentes temperatures.) ALFRED MOLNAR. *Revue de Metallurgie*, Vol. 27, Oct. 1930, pages 522–534.

Pb, Sn, Cd and Zn were strained 25 and 50% at different temperatures in the range —75° to 200° C. The specimens were then kept at the same temperatures and their hardness was measured at intervals without changing the temperature surrounding them. All these metals are susceptible to strain hardening. The amount of it depends on the temperature of deformation and the temperatures at which specimens are kept after straining. Pb strained and kept at —40° retains its accrued hardness indefinitely. Strained and kept in the range —40° to 50° it gradually loses the acquired hardness, returning to the annealed condition. Above 50°, no hardening takes place because the strains are instantaneously relieved. Sn remains strained at —20° and is instantaneously relieved at 50°. For Cd these figures become respectively —40° and 25°. Zn does not soften under 15° and the instantaneous relief of the strain calls for 300°. These results were confirmed by X-ray study. Tensile testing at different temperatures and using 2 cm./min. and 70 cm./min. loading speeds showed that at faster loading the metals behave as if they were strained. The increase in temperatures reduces the difference between the results obtained by fast and slow pulling until they become the same. This occurs for Pb at 80°, for Sn at 100°, for Cd at 50° and for Zn at 150° at which temperature strains seem to be instantaneously relieved. JDG(6)

Creep Limit under Alternating Tension and Compression. (Der Fliessbeginn bei wechselnder Zug-Druckbeanspruchung.) W. KUNTZE & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Vol. 14, 1930, pages 77–82.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 36. (6)

Wear Resistance of Dies Studied. *Chemical & Metallurgical Engineering*, Vol. 36, Oct. 1929, page 617.

United States Government is investigating the abrasive action of plastic clay in flowing through dies, in order to determine the relative "wear values" of different metals used for lining dies. The data obtained from 10 tests on cast-iron and 44 on C-Cr steel indicate that the relation between extrusion pressure and abrasion loss of metal is a straight-line function according to the the equation $\frac{PS}{W} = K$, in which P is the extrusion pressure, S, the sp. gr. of the metal, W the loss of the metal in weight, and K, a constant characteristic of the wearing quality of the metal. Value of K for cast-iron as compared to that for C-Cr steel is as 1 to 10.116. MS(6)

Standardization of Methods for Testing the Fatigue Resistance of Metals. (Normalisierung des Prüfverfahrens zur Ermüdung an Metallen.) K. LAUTE (Staatliches Materialprüfungsamt, Berlin-Dahlem). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 111–118.

Brief statement of principles of fatigue testing. Short-cut methods are inaccurate because they do not bring in the work-hardening factor. Up to 6000 cycles per minute, speed of testing is without effect. Very high-speed tests (30,000 per minute) give erroneous results as they do not allow time for strengthening by understressing. Effects of surface finish and of corrosion are discussed. A table showing the effect of grooves 0.003" deep states that various steels, Lautal, Scleron and Electron drop 8 to 28% in endurance limit when grooved, but that drawn commercial copper rod is unaffected. The endurance limit of this material is given as 17,000 lbs./in.² in the table, but shown as 13,000 lbs./in.² in a curve. The endurance limit is not of extreme value for design purposes because in practice one seldom knows the true maximum load. HWG(6)

Fatigue. (Ermüdung.) P. LUDWIK (Technische Hochschule, Vienna). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 119–132. 17 references.

The fatigue limit for annealed electrolytic copper is given as 13,000 lbs./in.² and when grooved 0.008" deep, 10,000 lbs./in.² Ordinary cast iron or high strength cast iron of 35,000 lbs./in.² tensile strength is unaffected by grooves, the endurance limits being respectively 10,000 and 20,000 lbs./in.² Heat-treated duralumin, annealed yellow brass, yellow brass cold-worked 10% and soft 18–8 steel were also not affected by the groove. All other materials tested were injured by the groove. The character of the surface at the base of the notch is of more importance than the depth of the notch. The German structural steel (No. 37) 50,000 lbs./in.² tensile, 27,000 lbs./in.² endurance limit polished, 21,500 lbs./in.² endurance limit notched in the soft state, on quenching in water from 700° C. and aging 2 weeks at room temperature, rose to 79,000, 44,000 and 41,000 lbs./in.² for the 3 values. Single blow notch bar impact tests do not indicate the susceptibility of an alloy to the notch effect in fatigue, nor does the "damping power" of the alloy. Damping is not a constant of the material, but changes with the nature and intensity of the stress, and with the number of stress cycles that have previously been withstood. A table of static and fatigue properties of 25 alloys is given. Ludwik admits that yield point has no direct relationship to endurance limit, but nevertheless inclines toward the formula-endurance limit = 0.3 (yield point + tensile strength) for calculating endurance limit. However, the formula is only good to ±20%, and does not apply at all to age-hardened light alloys. HWG(6)

A Note on Fatigue Tests of Nitrided Steel. N. L. MOCHEL. *Proceedings American Society for Testing Materials.* Vol. 30, Pt. 2, 1930, pages 406–410. Includes discussion.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

Constancy of the Work Done to Fracture. (Konstante Brucharbeit als Erklärung für den Bruch durch Ermüdungs- und andere Belastungen.) K. LJUNGBERG (Technische Hochschule, Stockholm). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 149–154.

Data are cited to show that if a tensile test is interrupted and resumed several times, the fracture occurs when the total area of all the hysteresis loops corresponds with the work necessary to cause fracture in un-interrupted loading. This is thought to extend to fatigue fractures as well and to account for the relationship between tensile strength and endurance limit. Three tests on steels are given, but no experiments are reported on non-ferrous metals in which the tensile-endurance relationship does not hold. HWG(6)

A Study of Slip Lines, Strain Lines, and Cracks in Metals under Repeated Stress. H. F. MOORE & T. VER. *University of Illinois Bulletin* No. 209, June 3, 1930, 62 pages; *Metallurgist*, Sept. 1930, pages 141–142.

Study of the mechanism of the fracture of metals under stress and the interrelation and significance of such phenomena as slip lines, strain lines, fatigue cracks and other signs of structural damage to metals. The following materials were studied: Armco Iron; 0.20 Carbon Steel S.A.E. 1020; Chrome-Nickel Steel S.A.E. 3135; Stainless iron (Ascoloy); Brass; Monel metal; Duralumin. Results are tabulated. Profuse micrographic illustrations. VVK(6)

Tensile Strength, an Instability Phenomenon. (Die Zugfestigkeit, eine Labilitätserscheinung.) P. MELCHIOR. *Forschung und Technik*, 1930, pages 533–538.

In carrying out a tensile test, the load is not increased arbitrarily but the elongation, ϵ, is impressed and the resistance, σ, against elongation is observed. The tensile strength has, therefore, no direct relation to the fracture; it is an unstability phenomenon of cylindrical or prismatic test rods. The faster the elongation velocity, μ, the greater the resistance, σ. These 3 variables, ϵ, σ and μ, are used as a means for correlating the results of tensile tests with the results of endurance tests. It follows that (1) tensile test and endurance test are tests of an entirely different nature which must not be confused with each other; (2) the results of tensile tests with definite elongation velocity permit the recognition of laws of endurance strength; (3) the results of endurance tests can be supplemented by tensile tests under simultaneous observation of the elongation velocity. Ha(6)

Magnetic Testing of Non-Uniform Material. (Prüfung ungleichmässigen Werkstoffes auf magnetischem Wege.) W. S. MESSKIN. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 215–220; *Stahl und Eisen*, Vol. 50, Dec. 11, 1930, page 1751.

The author describes a new method to determine the magnetic properties of non-uniform material, i. e., material, the core of which has other magnetic characteristics than the skin. Exact determinations of the normal induction curve show that it is really composed of 2 branches provided the material is non-uniform. From these curves, the maximum permeability can be found by a simple geometric procedure and the coercive forces can then be determined by certain approximate calculations. The approximate formulae are given as well as the theoretical principles of this new method. GN(6)

Dynamic Properties of Magnesium Alloys. (Proprietà dinamiche delle leghe ultra leggere.) I. MUSATTI. *La Metallurgia Italiana*, Vol. 22, Dec. 1930, pages 1052–1068.

Rotary beam endurance tests on a McAdam type tapered cantilever bar were made on a group of magnesium alloys and compared with duralumin. Tests were carried to 60 million cycles. If the S-N curve was flattening out, it was extrapolated to 100 million and the corresponding stress taken as the engineering endurance limit. If it was not, extrapolation was made to 1 billion cycles. After running 60 million at a stress a little below that taken as the endurance limit, specimens of alloys A, E, Fh and If were run at higher stresses, and showed material strengthening by understressing, thus affording evidence that the magnesium alloys probably have a true endurance limit. Care was taken to avoid corrosion during storage and in the endurance tests, by oiling the specimens. The extruded 4% Cu alloy of Mg was very poor in endurance and repeated impact. That with 4% Zn was nearly as good as those with 6½ to 10% Al, plus a little Mn, in endurance, but not quite so good in repeated impact. The Al-Mn alloys of Mg were slightly superior to heat-treated duralumin in endurance, but not as good on repeated impact. The repeated impact tests were made on an Amsler machine using a 1 mm. deep, 5 mm. wide, 3.63 mm. radius round notch. With log plotting of energy of blow against number of blows to fracture, the plots were straight lines in most cases, down to 2 kg. cm., the smallest energy used, no sign of a repeated impact endurance limit being evident. In alloys F, Fh, Fw and D (all alloys with Al), the plots were somewhat curved, below 3 kgcm., as was the case with duralumin. Single blow notched bar impact tests, made in a 15 kg. m. Amsler machine on 10 × 10 mm. Charpy bars with a 2 mm. deep, 2 mm. wide Mesnager notch of 1 mm. radius, were carried out over a range of temperatures from —50° to +50° C. In the extruded materials, those with the smaller amounts of alloying elements, i. e., those weaker in tension, were generally superior in single blow impact. All, however, were relatively weak. Alloy G was a trifle weaker at +50° C. than at room temperatures; all the others were better. All the Mg alloys were the more brittle the more the temperature was dropped below room temperature, though the very brittle cast Mg alloys showed but a slight drop. On the other hand, the heat-treated duralumin showed marked improvement in impact resistance at temperatures below 0° C., and a slight decrease at +50° C. The curves for duralumin and for Mg alloys have opposite trends. The angle through which the Charpy bar had bent before fracture was measured after fitting the broken halves together. Duralumin showed a larger angle at —50° than at +50° C. while the reverse was found for the Mg alloys. On the whole the extruded alloys of Mg with Al, plus a little Mn appeared somewhat superior to those alloyed with Zn, and very much superior to those with Cu. The static properties and the repeated impact properties of 2 cast Mg alloys containing Al and Zn were compared with those of cast silumin (Al with 12½% Si). The silumin rotary beam endurance bars were so full of flaws that no good endurance tests could be made. Fatigue data on cast silumin by Wagner would indicate it to be decidedly inferior to the cast Mg alloys. The data are collected in the following table:

Methods Employed in the Mechanical Testing of Aero Steel Strip. E. SKERRY. *Aeroplane*, London, Vol. 38, Feb. 26, 1930, pages 352–353.

The method of testing steel strip which commends itself, is the one that gives accurate readings quickly without use of elaborate apparatus. The provision of a suitable test piece, the selection of extensometer, and the elimination of the personal element in the bend test are necessary. (6)

Specimens for Torsion Tests of Metals. R. L. TEMPLIN & R. L. MOORE. *Proceedings American Society for Testing Materials*. Vol. 30, Pt. 2, 1930, pages 534–545.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

Strain Gages. F. G. TATNALL. *Product Engineering*, Vol. 1, Apr. 1930, pages 158–159.

Descriptions are given of the Whittmore gage for strain measurements, Olsen-Lewis strain gage, Berry strain gage, electric telemeter and Huggenberger tensometer. (6)

An Apparatus for the Determination of Creep at Elevated Temperatures. A. E. WHITE, C. L. CLARK & L. THOMASSEN. *Metal Industry*, London, Vol. 37, Aug. 1, 1930, pages 105–107.

Contributed by the Joint Research Committee on the effect of temperature on the properties of metals at semi-annual meeting of the American Society of Mechanical Engineers at Detroit, June 9 to 12, 1930. A creep testing apparatus developed at the University of Michigan which is capable of measuring elongation to 2.8 millionths of an in./in.² on a 2-in. gage length is described. VSP(6)

Elastic Behavior of Spring Materials. M. F. SAYRE. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 546–558.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 847. (6)

Tensile and Impact Tests at Low Temperatures. (Zerreiss- und Schlagversuche bei tiefen Temperaturen.) P. SCHOENMAKER (N. V. W. Smit & Co., Holland). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 237–250.

Tests from room temperature to —80° C. on 5 carbon steels of 0.14 to 1.75% C. on a 25% Ni steel, on 60:40 and 70:30 brass, copper and zinc. All become stronger in tension as the temperature decreases (zinc was not tested). Hypoeutectoid steels decrease in impact resistance. The hypoeutectoid steels and Zn, all with low impact strength, retain their impact values without much change. The brasses and copper show somewhat improved impact resistance at the lower temperatures. Impact values are not given on the 25% Ni steel. HWG(6)

Effect of Metallic Coating upon Fatigue. R. H. D. BARKLIE & H. J. DAVIES. *Engineer*, Vol. 150, Dec. 19, 1930, pages 670–673.

Selected for publication in the Proceedings of the Institution of Mechanical Engineers. Tensile stress in Ni, electro-deposited on a steel test piece which is subjected to a fatigue test, acts like a mean stress and seriously reduces the fatigue limit. This reduction is greater than that produced by a circular nick of depth equal to the thickness of the Ni deposit. Electro-deposits of Ni having little internal stress have a greatly reduced influence on the fatigue range of the steel and the conditions for the electro-deposition of nearly stress-free Ni are described. Electro-deposits of stress-free Cu reduce the fatigue limit of steel. Electro-deposits of Zn having a slight internal stress causing them to expand do not lower the fatigue limit of steel. Electro-deposits of Pb are practically without influence. Intermediate Pb films between stressed Ni and steel have been found to insulate the steel core from the effects of the Ni. LFM(6)

The Endurance Strength of Non-Welded and Welded Cast and Rolled Materials. (Die Dauerfestigkeit ungeschweisster und geschweisster Guss- und Walzwerkstoffe.) B. BARTELS. *Giesserei Zeitung*, Vol. 27, Nov. 15, 1930, pages 607–616; Dec. 1, 1930, pages 637–645; Dec. 15, 1930, pages 661–669.

The endurance strength of the main construction materials was tested in the welded and non-welded state. Lehr's short time method was found to be applicable also to welded materials. The endurance strength of cast Fe essentially depends on the shape of the graphite present. Lamellar graphite close to the surface of the specimens may bring about a notch effect, impairing the endurance strength. Surface injuries due to machining did not decrease the strength of cast Fe. Polishing does not bring about an improvement. Graphite in eutectic arrangement in a pearlitic matrix increases the endurance strength about 3 times above the normal values. The endurance strength of welded cast Fe is generally somewhat lower than that of non-welded Fe. The tensile strength of welded cast Fe decreases more than the endurance strength. Steel, copper and silumin were also tested. GN(6)

		Composition, %							Static Properties						
Mark	Condition	Mg	Al	Si	Fe	Cu	Zn	Mn	Prop. Lmt. (0.001%) lbs./in.²	Yield Point lbs./in.²	Tensile Strength lbs./in.²	Red. Area %	Elong. %	Compress. Yld. Pnt. lbs./in.²	Compress Strength. lbs./in.²
A	Extruded	93.39	2.22	0.02	0.03	3.98	..	0.36	3,700	6,400	32,700	17½	12½	14,800	51,000
B	Extruded	94.97	4.13	0.08	Tr.	0.07	..	0.75	9,400	10,700	....	..	....	....	....
C	Extruded	95.45	0.21	0.08	0.04	Tr.	4.22	Tr.	10,000	10,000	37,500	31	15½	17,500	53,000
D	Extruded	92.55	6.67	0.04	0.03	0.02	0.50	0.19	11,500	20,600	46,500	24½	11½	26,500	61,000
E	Extruded	93.94	5.72	0.19	0.03	0.12	..	Tr.	13,900	15,000	50,500	26½	6½	29,500	62,500
F	Extruded	88.40	10.63	0.19	0.03	0.04	Tr.	0.71	12,900	19,900	49,000	19½	11	30,500	68,500
Fh	Extruded and hardened	89.04	10.08	0.19	Tr.	0.04	..	0.65	16,000	22,800	57,500	4½	2	42,000	74,000
Fw	Extruded and straightened	88.95	10.75	0.09	0.03	..	..	0.17	14,300	22,800	52,000	18½	10½	26,000	66,000
G	Extruded	90.78	8.73	0.03	0.02	0.08	..	0.36	15,200	....	62,000	12	5	45,000	68,000
H	Extruded	95.58	3.26	0.20	Tr.	0.06	0.40	0.50	8,800	10,700	40,000	36½	10½	19,500	58,000
If	Cast	91.44	4.36	0.15	0.06	0.08	3.56	0.35	2,400	6,500	23,900	6	4½	....	49,000
Ig	Cast	89.52	6.59	0.25	0.04	0.16	3.20	0.24	4,200	6,000	18,500	..	1½	....	52,500
Duralumin heat treated		0.56	94.03	0.35	0.43	3.94	..	0.69	21,800	35,000	60,500	40	17½	....	....
Silumin cast		Tr.	87.05	12.42	0.47	0.02	..	0.04	3,300	6,500	25,500	10	7	....	....

	Static Properties		Dynamic Properties										
			Endurance Limit, lbs./in.², 60 Million Extrapolated to		Repeated Impact No. of Blows at		Notched Bar Impact Kgm./Cm.²					Angle at	
Mark	Shear Strength, lbs./in.²	Brin. Hrd. 60 ±	100 Million	1 Billion	10 Kg. Cm.	2 Kg. Cm.	−50° C.	−20° C.	°0°C.	+15° C.	+50° C.	−50° C.	+50° C.
A	17,500	.....	7,500*	....	700	40,000	0.48	0.48	0.61	0.64	0.63	2°	6°
B	....	.....	....	....	...	.....	..	..	..	..	..	....	.....
C	18,000	50–60	16,000	....	1,500	70,000	0.73	0.77	0.89	1.00	1.08	3° 30′	5°
D	20,000	75–80	....	17,000	5,000	350,000	0.77	0.83	0.98	1.14	1.40	3° 50′	5° 20′
E	22,500	70 ±	....	16,000*	...	.....	..	0.75	0.79	0.94	0.97	....	....
F	21,500	80–90	....	17,500	6,000	1,400,000	0.37	0.40	0.50	0.57	0.61	1°	3° 40′
Fh	24,000	100–110	....	18,000*	1,800	300,000	0.21	0.21	0.23	0.25	0.25	....	.....
Fw	20,500	70–80	....	17,500	7,000	250,000	0.55	0.61	0.74	0.85	1.00	2° 50′	5° 50′
G	26,000	105 ±	....	17,000 ±	...	.....	..	0.35	0.58	0.65	0.58	....	.....
H	18,500	70–80	....	15,500	...	.....	..	0.91	0.96	1.02	1.34	....	.....
If	17,000	59 Av.	9,000±*	....	500	40,000	..	..	..	..	..	....	.....
Ig	18,000	64 Av.	....	....	100	20,000	0.20	0.20	0.20	0.22	0.24	....	.....
Duralumin heat treated	35,000	115	....	16,000	10,500	4,500,000	4.90	4.35	4.18	4.17	3.95	18°	10° 30′
Silumin cast	16,000	55 Av.	5,500**	....	250	20,000	..	..	..	..	..	....	.....

* Checked by coaxing test.
** From data of Wagner.

HWG (6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Some Experiments on the Electro-Deposition of Gold from Alkaline Cyanide Solutions. E. T. DUNSTAN. *Journal Chemical Metallurgical & Mining Society of South Africa*, Vol. 31, pages 118–127 (1930).

No evidence of regeneration of cyanide by electrolysis of a working cyanide solution was found, in fact, a further loss occurred. The use of a rotating cathode does not materially increase the current efficiency, which is extremely low, due to the dilute solutions employed. Electrolytic methods cannot economically improve upon zinc precipitation. It is doubtful if space and power would be saved, as the solution required four passes through the cell. The rotating cathode has a depolarizing effect, probably due to the friction of the solution keeping the surface free from bubbles of gas, which enables a lower voltage and higher current density to be employed. AHE(7a)

Measurements of Hydrogen Ion Concentration in Plating Baths. R. E. BREWER & G. H. MONTILLON. *Transactions American Electrochemical Society*, Vol. 55, 1929, pages 357–382.

Includes discussion. Discusses the theory of the hydrogen, oxygen, quinhydrone, antimony and lead oxide electrodes for the determination of pH in acid plating baths. The limitations of the various electrodes in typical nickel, cobalt, iron, zinc and chromium plating solutions are indicated and the results are given of a comparative study of the electrometric and colorimetric methods of measuring hydrogen ion concentration. The oxygen electrode is found to give good results in nickel and cobalt baths and to be useful in checking other methods of measurement. For general usefulness, as well as ease of measurement, the quinhydrone electrode is recommended. (7a)

Improvement in Electroplating Quality Needed to Meet Competition. E. B. NEIL. *Automotive Industries*, Vol. 63, Oct. 18, 1930, pages 560–564.

The article discusses in detail the quality of plating on present-day vehicles, nickel plating, heat treating of chromium plate, durability tests, control methods, chromium plating for resistance to abrasion, electrodeposition of iron and future prospective progress in electroplating. GN(7a)

Proposed Chromium Plating Regulations. *Metal Industry*, N. Y., Vol. 28, Sept. 1930, pages 431–432.

Summarizes regulations put forward by British Governmental Dept. to reduce the health hazard in Cr plating to a minimum. Results of investigation showed that of 223 persons examined about 43% had dermatitis, while nasal changes were observed in about 52%. Caused by spray due to evolution of gases. May only be eliminated by efficient exhaust ventilation. VSP(7a)

Chemicals Used in Electroplating and Metal Finishing. *American Machinist*, Vol. 73, Dec. 11, 1930, page 937.

List of chemicals, chemical formula, common name, color, form, grades and size of standard containers. RHP(7a)

Chromium Plating. *Electrical Review*, Vol. 107, Nov. 28, 1930, pages 930–931.

Extracts from the proceedings of the Electroplaters' and Depositors' Technical Society. Consists of a discussion of the proposed British Home Office regulations for safe-guarding the health of workers, and of an abstract of a paper by J. W. Cuthbertson on practical difficulties in electrodeposition. MS(7a)

Plating of Electrical Appliances. *Metal Cleaning & Finishing*, Vol. 2, March 1930, pages 229–231.

Describes procedure and gives solution formulae of the Westinghouse Electric and Manufacturing Company's plant at Mansfield, Ohio, for Cr and Cd plating of electric iron parts, reflectors and miscellaneous appliances. MS(7a)

Electrodeposition of Chromium for Engineering Service. *Metal Cleaning & Finishing*, Vol. 2, Feb. 1930, pages 131–136.

Describes the practice of the U. S. Chromium Corporation, Wilkinsburg, Pa. for producing a hard wear resistant surface on steel rolls, dies, etc., and for producing lustrous surfaces. Includes solution formulae. MS(7a)

Electroplating Aluminum. *American Metal Market*, Vol. 37, Dec. 26, 1930, pages 4, 10.

A reprint from a booklet issued by the Aluminum Co. of America. The best plating procedure for different types of Al alloys is discussed in sections covering alkaline cleaning, acid cleaning, plating on a smooth surface (Cr, and Zn "Flashing"). Ni plating of Al is desirable but requires "roughening." For roughening commercially pure Al (2 S) an etching solution contains: nickel chloride 36 oz., hydrochloric acid 0.2 gal., water 1 gal. Operation is conducted at 90° F. The roughening of alloys of the 2 S and Strong Alloys group is accomplished in a dip containing: hydrochloric acid 1/3 gal., water 2/3 gal. and manganous sulphate 1/2 oz. The temperature is 90° F. For castings, the dip contains: nitric acid 3 parts, hydrofluoric acid (48–52%) 1 part, temperature 75–80° F. Heavy Cr deposits (.001") may be applied directly to the castings after the Al surface has been roughened by this dip. WHB(7a)

Practical Handbook on Electro-Plating. W. Canning & Co., Birmingham, 1928. Cloth, 6 × 9 1/2 inches, 298 pages.

This little book is a very convenient and helpful treatise for the practical electroplater and metal worker. The compilers and publishers have been supplying the British electroplating industry with high-grade standard equipment, plating solutions and accessories for many years. The text, therefore, is based on a very wide range of experience and the various procedures recommended are authoritative.

The first section of the book (60 pages) covers "Grinding and Polishing;" the second, "Cleaning and Dipping" (20 pages); the third and main section, "Electro-Plating" (50 pages); and the last, "Bronzing, Lacquering and Enamelling" (44 pages).

Although the only apparatus, equipment and salts cited or recommended are "Canning," and little or no reference is made to other sources, nevertheless, the little book is full of useful information for the commercial electroplater. Numerous illustrations add greatly to the value of the book.—Colin G. Fink (7a)-B-

Electrometallurgy (7b)

Another Porphyry Copper in the Making. GEORGE J. YOUNG. *Engineering & Mining Journal*, Vol. 130, Nov. 24, 1930, pages 522–524.

The development of the Bagdad Copper property near Hillside, Arizona, its prospects and reserves and details of pilot-plant construction and operation are briefly outlined. A flowsheet of the concentrating mill and the experimental hydrometallurgical plant are shown. WHB(7b)

Principles of Calculating for Electrolytic Copper Refining Plants. (Grundlagen zur Berechnung von Electrolytischen Kupferraffinationsanlagen.) FRIEDRICH VOGEL. *Metall & Erz*, Vol. 27, March 1930, pages 150–155.

In laying out an electrolytic Cu refining plant, many factors must be considered such as daily output, quantities of raw material available, composition of raw material, type of solution to be used, availability and cost of electric current, size of units and electrodes, current density. Statistics are given for the plants at Raritan, Great Falls and El Paso. CEM(7b)

INDUSTRIAL USES & APPLICATIONS (9)

Bimetal—Its Function and Application. W. J. P. ROHN. Part 1, *Metallurgia*, Vol. 3, Nov. 1930, pages 17–19, 25; Part 2, Dec. 1930, pages 59–61.

Bimetal strips are used for temperature measurement or temperature control. They are made by soldering, welding or riveting 2 strips of dissimilar metals. Ni-Fe alloys are usually used for the strip having the low coefficient of expansion. Cu, Al, Fe-Ni alloys and various other materials can be used for the other strips but the materials used should have a high elastic limit. Cu and Al are not very satisfactory. Bimetals made from dissimilar Fe-Ni alloys are the most satisfactory. The addition of 5% Mo to these alloys makes them less susceptible to variations in heat treatment. Curves are given showing the coefficients of expansion of various metals and alloys at different temperatures and the deflections of several bimetal strips over a range of temperatures. Part 2 gives effect of dimensions on action of bimetal strips. In order to obtain the greatest deflections the strips should be as thin as possible, but the force exerted by the free end is proportional to the third power of the thickness. Describes equipment for testing strips. The strips should be cold rolled and heat treated to obtain the maximum strength and elasticity. The 2 parts should be firmly attached to each other. Bimetal strips are capable of yielding high precision results. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 342. JLG(9)

Ferrous Metals Used in Airplane Construction. J. B. JOHNSON. *Proceedings American Society for Testing Materials*. Vol. 30, Pt. 2, 1930, pages 28–33.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (9)

The Place of Iron Casting in Industry. *Engineering*, Vol. 128, Dec. 13, 1929, pages 776–777.

Comments on advances which have been made in recent years in improvement of cast-iron. British Cast Iron Research Association has done much toward developing little known properties of cast-iron. Heat-resisting properties of cast-iron have been studied. At the Engineering Experiment Station of the University of Illinois, work is being done on the relation between fatigue strength and other mechanical properties. Professor Hanson of the University of Birmingham is making a study of the whole subject of cast-irons. The fact that the British Engineering Standards Association now has a specification for cast-iron shows that progress is being made. LFM(9)

Solid Nickel and an Industrial Revolution. P. E. NORWOOD. *Australian Manufacturer*, May 4, 1929, pages 19 and 41.

Popular account of the applications of nickel and Monel Metal in the dairy, textile dyeing and other chemical and semi-chemical industries. (9)

Insulated Aluminum Wires and Cables. *Electrical Railway Journal*, Vol. 75, Jan. 1931, pages 51–52.

Under the trade name Electral, insulated aluminum-wires and cables have been announced by the General Cable Corp. The initial group of insulated aluminum conductors includes net work cable, non-metallic underground cable, insulated line wire, tree wire, armored cables, magnet wire, starter cable and car wiring cable. Connections will be made by applying high pressures to sleeves by means of a specially designed lightweight hydraulic press. Where tensile strength is not of prime consideration, conductors of Electral wires and cables are all aluminum. WHB(9)

How Germany Has Successfully Developed the Welded Ship. *Iron Age*, Vol. 126, Aug. 21, 1930, pages 481–484.

Comparison of weight and cost of welded and riveted ships showed the welded vessels weighed less but the cost was slightly greater. North German Lloyd specifications used for short cruising coastal vessels. Material must be carefully laid out. Each seam should be completely welded before beginning the next. Special attention paid to preparation of seams joining thick plates with thin ones. Lengthwise seam in tank compartment does not constitute an element of danger. VSP(9)

Notably Light Airplane Wings of Alloy Steel Heat Treated. *Iron Age*, Vol. 126, Aug. 21, 1930, page 485.

Steel wing beams comparing in lightness and strength with Al alloys are manufactured by the Metlab Metallurgical Laboratories, Inc., Philadelphia. Beams are of Warren truss type of Cr-Mo steel tubing No. 4130X with an analysis of 0.25 to 0.35% C, 0.40 to 0.60% Mn, 0.04% maximum P, 0.045% maximum S, 0.80 to 1.10% Cr and 0.15 to 0.25% Mo. Cr-Mo tubing is heat treated to tensile strength of 150,000 lbs./in.^{2} Heat treatment is done in a vertical electric furnace and quenched in oil from 1600° F. Weight of each beam is 43 lb. and length is 21 ft. 6 in. VSP(9)

Use of Rustless Steel in the Automobile Industry. *Metal Cleaning & Finishing*, Vol. 3, March 1930, pages 204, 210.

Ford Motor Co. has adopted rustless steel for exposed metal parts, after subjecting the alloy to many severe tests. Samples were tested by the salt-spray method for 400 hrs. without showing any visible attack. A sheet of the metal placed in highly corrosive mine water and removed after 6 months' total immersion, showed no loss in weight. MS(9)

Pearlitic Manganese Steel for Rails. (Perlitischer Manganstahl als Schienenbaustoff.) A. POHL. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1574–1580.

The article gives the results of physical tests and practical tests of Mn rails made either in the electric furnace or the open-hearth furnace. It is shown that the pearlitic Mn steel (C: 0.55–0.72; Si: 0.16–0.27; Mn: 1.62–1.89) possesses a high yield point and a high tensile strength, favorable capacity of deformation and high wear resistance. The economic application of Mn steels is discussed. GN(9)

Copper and Its Alloys in Motors and Aircraft. L. S. REID. *Aviation Engineer*, Vol. 3, May 1930, pages 20–22.

Specifications, chemical composition and physical properties of Cu alloys used for seamless tubing, wrought pieces and castings are given. Graphs show Cu-Zn constitution diagram comprising alloys of Cu. (9)

The Replacement of Castings by Weldings. P. L. ROBERTS. *Welding Journal*, Vol. 27, Oct. 1930, pages 297–302; discussion in Nov. 1930, pages 326–328, 342.

Paper read before the Institution of Welding Engineers, Oct. 1930. The advantages of weldings over castings are first presented; strength, lightness, economy. Concrete examples of the replacement of castings by weldings are given and the possibility of a wider field emphasized. Current practice in the construction of a few specific weldings is given. Steam condensers, alternator yokes, bedplates and the like constitute the work with which the author had to deal and he discusses the merits of the welding in these instances. AWM(9)

Comparisons Between Welded and Riveted Joints. (Comparison entre l'Assemblage rivé et soudé.) D. ROSENTHAL (Testing Laboratory, University of Brussels). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 163–167.

Properly welded joints are preferred to riveted ones. (9)

Applications of Stampings, Forgings & Castings in Aircraft Construction. H. G. RUNDE. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 77–87.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (9)

Corrosion of Copper and High Copper Bearing Alloys by Salt Solutions with Particular Reference to the Conditions Prevailing in Potassium Salt Industry. (Ueber die Korrosion von Kupfer und hochkupferhaltigen Legierungen durch Salzlösungen unter besonderer Berücksichtigung der Verhältnisse in der Kaliindustrie.) A. RAUCH & H. KOLB. *Korrosion und Metallschutz*, Vol. 6, June 1930, pages 127–132; July 1930, pages 151–156; Aug. 1930, pages 174–178; Sept. 1930, pages 193–200. 43 references.

A problem of commercial significance precipitated the present investigation: the corrosion attack of chlorides and sulphates of K, Na and Mg in preheater tubes of Cu and Cu-bearing alloys in potassium salt industry. Experiments were carried out partly in the laboratory and partly on a quasi-commercial scale. Determinations of corrosion attack were performed by Cu analyses of the corroding medium. The following factors were studied: influence of concentration, temperature, time, O content of the electrolyte, aqueous solutions, corrosion attack by solid salts. The material investigated consisted of various grades of copper, brass and bronze. The superiority of Cu-alloys (except tin-bronzes) in comparison with brands of Cu was established. Additions of Al materially improve the corrosion resistance. The local dezincification of brass is pointed out. The surface conditions of the material tested is considered and potential measurements are carried out. Experiments with Tödt's Korrosimeter did not turn out satisfactorily. In conclusion, the authors report on experiments on a large scale which in general confirmed the laboratory tests showing the most favorable behavior on the side of the Al-bronze. EF(9)

Hardened Rails. (Gehärtete Schienen.) W. OERTEL. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1584–1585.

The article briefly discusses the 3 most important methods for the improvement of rails by surface hardening, the Sandberg method, the method Neuves-Maisons and the Maxhütte method. The method of the Maxhütte seems to give the best results and seems, therefore, to be most adaptable for practice. GN(9)

The Development and Use of Alloy-Steel Castings in Modern Industry. H. D. PHILLIPS. *Pit & Quarry*, Vol. 20, June 18, 1930, pages 54–56.

A discussion of the properties imparted by Cr and Mo and the manufacture of castings. (9)

Iron and Steel Used in a Modern Brass and Copper Mill. H. G. KESHIAN. *Iron Age*, Vol. 126, Nov. 6, 1930, pages 1282–1286, 1359–1360.

Brass and Cu mills have always used Fe and steel in construction of their equipment. In melting brass and Cu low-C-high-Cr iron is used for stirring molten metal. For mold material gray Fe ingot molds are employed. For scalping, overhauling and milling cast and rolled bars and ingots, high-speed steel is preferred. Use of steel rolls for breaking down and finishing operations is steadily gaining ground. No standard type of steel as to chemical composition is to be found for cold shearing of sheets. Heat treated alloy steel chains made of either Cr-Ni, Cr-V or pearlitic Mn steels are proving superior to medium C steel chains for cold drawing equipment. Steel to cold draw brass and Cu must have maximum wearing properties without tendency to scratch the work. Steels for drawing dies generally have from 1.25% to 1.35% C, 4% to 5% W, or 2% C and 5% Cr, or 2% C and 12% Cr. In hot working brass and Cu types of steels used are not expected to fill a stricter demand than for hot working Fe and steel. Hot working steels are classified as follows: (1) these contain C and Cr; (2) C, Cr and W; (3) C, Cr, W and V; (4) C, Cr, W, V and Ni; (5) C, Cr and Mo. In fabrication of various articles from brass and Cu, kind of steel is not different from steel used on similar operation in fabricating iron and steel articles. VSP(9)

Building Contractors Favor Steel Equipment. *Steel*, Vol. 87, July 17, 1930, pages 48, 50.

Sidewalk bridges, material towers and scaffolding made of steel are replacing wooden structures. MS(9)

Manganese Steel is Employed in Kill van Kull Bridge. *Steel*, Vol. 87, July 17, 1930, pages 57, 60.

Lower cord of the bridge is fabricated from Mn steel rolled plates and shapes with Mn steel rivets. Composition of the steel is 0.40% maximum C, 1.80% Mn, 0.04% P, 0.05% S and 0.10–0.30% Si. Physical properties are: ultimate strength, 9000 lbs./in.^{2}; yield-point, 55,000 lbs./in.^{2}; elongation, 16%; and reduction of area, 30%. Rivets were slightly softer than the rolled shapes and had an ultimate strength of 82,000 lbs./in.^{2} and a yield point of 47,000 lbs./in.^{2} Cost of steel is 0.75 cents/lb. less than the price stipulated for Ni steel. Si steel has been specified for cross-pieces and C steel for the approaches and for some of the arch members. Some heavy C steel forgings were used in the construction of the shoe. MS(9)

Nickel Coinage. *Canadian Mining Journal*, Vol. 52, Jan. 9, 1931, pages 44–45, 55.

From "The Nickel Bulletin" (Mond Nickel Co.). A large potential market for nickel as coins remains, particularly in the British Empire. WHB(9)

Fabrication of Metal Furniture. *Metal Stampings*, Vol. 3, June 1930, pages 559–562.

Describes some of the applications of sheet steel and seamless tubing to procedures. Welding is used for assembling. MS(9)

Improved Metals Affect All Products. *Product Engineering*, Vol. 1, Sept. 1930, pages 421–423, 433.

Brief discussions on metal applications by the editors of *Chemical & Metallurgical Engineering, Aviation, Bus Transportation, Engineering News-Records, Power, and Electric Railway Journal.* (9)

Use of Light Metals in Mines. (Verwendung von Leichtmetall im Bergbau.) E. LOHRKE. *Metall und Erz*, Vol. 27, Oct. 1930, pages 521–524.

On account of the limited space in mines and the necessity of using many manually operated tools and devices, the use of light metals is desirable. Their application for ventilators, water pumps, lamps, boring tools, air compressors and mine transportation is described. CEM(9)

Use of Alloy Steels in Iron and Steel Mill Equipment. E. R. JOHNSON & O. BAMBERGER. *Transactions American Society Mechanical Engineers*, Vol. 52, Jan.-Apr. 1930, pages 5–8, discussion pages 8–9.

Substituting alloy steels for the ordinary C steels in its mill equipment is the practice of the Central Alloy Steel Corporation when occasion arises to make a change. Elimination of breakdowns and costly repairs is claimed to be furthered by certain uses of the alloys. A gradual building up of the alloy-steel equipment is taking place. In producing alloy steel itself, the initial cost is low. There are 3 requirements which permit the substitution of alloy steels: (1) Increase of the physical properties of strength, ductility and toughness; (2) The ability to withstand wear and abrasion; (3) Resistance to corrosion. Includes discussion. See also *Metals & Alloys*, Vol. 1, May 1930, page 525. (9)

Copper Steel for Dynamo and Transformer Sheets. A. KUSSMAN & B. SCHARNOW. *Metallurgist*, Sept. 1930, pages 142–143.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 912. VVK(9)

Plate-Type Residence Floors Offer Market for Steel. LEE H. MILLER (American Institute of Steel Construction). *Steel*, Vol. 87, July 3, 1930, pages 54, 66.

From a paper read before the American Iron & Steel Institute. See "Steel House Construction," *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. MS(9)

Materials of Construction in Aircraft Engines. R. R. MOORE. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 88–98. Discussion appended.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (9)

Chromium Plated Molds. H. E. STOCKFISCH (Westinghouse Electric & Manufacturing Co.). *American Machinist*, Vol. 73, Oct. 2, 1930, pages 553–555.

Resistance to wear is the principal justification and value of chromium plating in molds. In glass molds, for both blown and pressed objects, the combination of long wear, preservation of polished surface, elimination of lubricants, and ease of stripping, makes chromium plate an ideal material. Molten glass at 2,100° F does not reduce the adhesion of the plating. Plate should be 0.004 in. thick for good wear. Gives composition of some chromium plated molds which have been used successfully. Discusses hardness methods of replating when the first coat wears through. Old plating should be removed before a new coat is applied. Initial cost of chromium plating is high but it soon pays for itself. RHP(9)

An All-Metal Apartment House. *Iron Age*, Vol. 126, Aug. 14, 1930, pages 430–431.

Describes metal building designed by Bowman Brothers, Inc., Chicago. The frame work is to be of fabricated structural members. The walls will be insulated and the floor of battledeck type. Analysis of 3 types of metal wall was made. These are: (1) Sheet Al with Al framework; (2) Sheet Al with steel framework; and (3) Allegheny Metal, KA2, sheets to be clamped to the framework with straps. The building is to be fabricated almost entirely in shops. VSP(9)

Laundry Machinery Fabricated by Arc Welding. MAURICE TAYLOR (Lincoln Electric Co.). *Product Engineering*, Vol. 1, Sept. 1930, page 405.

Brief article mentioning saving due to replacing cast iron parts with welded steel parts. (9)

Structural & Engineering Light Alloys for Aircraft. R. L. TEMPLIN, F. V. HARTMAN & E. C. HARTMANN. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 34–40.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (9)

Some Unusual Pressed Steel Conversion Jobs. H. W. TINKER (Federal Pressed Steel Co.). *Metal Stampings*, Vol. 3, Jan. 1930, pages 13–16.

Deals with the design and manufacture of tire covers, bumpers, and brake drums. MS(9)

Report of the Technical Director. U. S. Government Printing Office. B. L. WEHMHOFF. *Appendix to Annual Report of the Public Printer for 1930*, pages 105–115. *U. S. Govt. Printing Office*, 1931.

Net dross losses, after recovery of metal from original dross, on remelting about 5½ million lbs. of linotype and 2½ million lbs. of monotype metals at the Government Printing Office in the last fiscal year were 0.48% and 1.74% respectively. The recovery of metal from the original dross was 46% and 47½% respectively. Changes in analysis were as follows:

	Linotype		Monotype	
	Standard for Metal in Use	Metal Recovered From Dross	Standard for Metal in Use	Metal Recovered From Dross
Sn%	4.0 to 4.5	3.55	7.3	5.22
Sb%	11.5	11.80	16.8	14.80
Cu%	0.05(*a*)	0.09	0.4(*b*)	0.14
Pb%	Balance	84.56	Balance	79.84

(*a*) average actual Cu 0.08%

(*b*) average actual Cu 0.15 to 0.18%

Difficulty was met in using stereotype metal of 8% Sn, 15.5% Sb, balance Pb in a 5 ton electrically heated pot, since Sb separated when the pot stood overnight, the top layer containing some 35% Sb. A new alloy of 6½–7% Sn, 12¾–13% Sb, balance Pb casts well at 600° F., pumps well, and the type is hard and tough enough to give 70,000 impressions on news print paper. With tin at 8%, a casting temperature of 650° F. was required. With Sb above 13%, the required temperatures were too high, and the tendency toward separation too great. The wear on type is chiefly due to battering through the first few thousand impressions. Wear during the first 10,000 is greater than between 35,000 and 70,000. Experiments are being run on the use of Bi in stereotype metal. A stirring device consisting of a cage that contains blocks of green wood and can be lowered to the bottom of the pot has been found of advantage in securing better mixing of metal. Work on electrotyping indicates that by use of addition agents, the present current density in Cu electrotyping, 70–80 amps./ft.^{2} can be raised to 150 amps. and still produce good shells. Work is under way on Ni baths. A study is being made of Zn plates for line cuts in photo engraving. HWG(9)

Locomotive Equipped with Roller Bearings. A. K. WEST (Timken Roller Bearing Co.). *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1147–1148.

Hardened and ground Ni-Mo steel, cast Ni steel, heat-treated Ni-V steel and normalized 2¾% Ni steel have been used for various parts and bearing mountings. MS(9)

Steel Ties versus Wood Ties. (Eisen- oder Holzschwelle.) R. VOGEL. *Stahl und Eisen*, Vol. 50, May 22, 1930, pages 721–729.

Experience of the German Federal Railway System indicates that steel ties are superior to wooden ties as regards maintenance of gage, resistance to lateral displacement, lessening of noise and increase in economy. GN(9)

Drop-Forge Metal Propeller. FRANK W. CALDWELL (Hamilton Standard Propeller Co.). *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 1000–1003.

Paper read before the Pittsburgh Aeronautical Meeting of the American Society of Mechanical Engineers. MS(9)

"Caro" Bronze as a Bearing Metal in the Automobile Industry. (Die Carobronze als Lagermetall in der Automobilindustrie.) A. D. SCHULZ. *Metallwirtschaft*, Vol. 9, Nov. 21, 1930, pages 969–970.

Caro bronze consists of 92% Cu, 8% Sn, ¼% P. It is made entirely from virgin metals, cast into ingots and cold drawn into tubes of the proper diameter for bearings. The author claims that it has better bearing qualities than any other known metal. The high tensile strength of Caro bronze enables its substitution for roller and ball bearings with consequent savings in material, weight and cost. Other advantages are noiselessness and high precision in workmanship. Four examples of the application of Caro bronze as bearings for automobile parts are described in detail. CEM(9)

Malleable Iron Castings in Automotive Design. H. A. SCHWARTZ *Product Engineering*, Vol. 1, Sept. 1930, pages 410–411.

Brief discussion of application of malleable castings in automotive construction. (9)

Comparing Experiments with Pistons of Light-Metal-Alloys. (Vergleichende Versuche über Leichtmetall-Kolbenlegierungen.) M. v SCHWARZ. *Zeitschrift für Metallkunde*, Vol. 22, Dec. 1930, pages 417–420.

The paper, which was presented before the Deutsche Gesellschaft für Metallkunde, Sept. 1929, discusses the efforts to produce high-quality pistons of light metals and is especially concerned with the devices which must be applied in designing and manufacturing the pistons. Chemical composition and physical properties of the most important alloys are listed. A testing machine is described which was designed by the author with the object of investigating the wearing properties of bearing metals and which can also be suitably used for testing the serviceability of light metal pistons. The paper includes 6 illustrations and a discussion. EF(9)

HEAT TREATMENT (10)

Mower Blade Steel Selected and Treated Carefully. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, May 29, 1930, pages 41–43.

Describes practice of the Coldwell Lawn Mower Co., Newburgh, N. Y. Hot-rolled strip steel containing 0.46% C and 0.80% Mn, is used for the blades which are heat treated and formed in one operation. MS(10)

Analysis of Electric Heat Treating of High-Grade Axes. WIRT S. SCOTT (Westinghouse Electric & Mfg. Co.). *Electric Journal*, Vol. 27, Sept. 1930, pages 511–514.

A comparison of results at the plant of the Warren Axe & Tool Co. before and after the change from gas to electric furnaces for the hardening and tempering of axes shows the advantages gained from the use of the electric furnace. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 428. WHB(10)

Devices for Making Locomotive Springs. JOSEPH C. COYLE. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 998–999.

In the Denver shops of the D. & R. G. W. Railroad, leaves are formed at 1600–1650° F., allowed to cool to a black heat, re-heated to a refining temperature of 1450–1500° F., quenched in oil, and drawn to 650° or 750° F. in a salt bath. A series of normalizing cooling racks enables the leaves to cool without warping. The salt bath is attached to the high heat furnace and is heated by the waste heat from it. Output has increased and much trouble from broken springs has been eliminated. MS(10)

Spring Wire Specially Heat Treated. R. W. COOK (Wallace Barnes Co.). *Iron Age*, Vol. 126, Sept. 18, 1930, pages 764–766, 828.

The largest number of springs are made from steel on account of its desirable properties such as strength, elastic limit, toughness, stiffness and endurance. Through various combinations of cold work and heat treatment spring material having tensile strength as high as 400,000 lbs./in.^{2} is produced. Spring steel containing up to 1% C may be folded on itself either across or with grain. Patenting is done continuously in muffle furnace. Springs which are heat treated are seldom made from wire smaller than 10 gage. High-C steels susceptible to H embrittlement are never immersed in acid. Flat strips are sand-blasted. Quenched and tempered springs cannot be rust-proofed by a process which requires preliminary cleaning in acid. Gives a stress strain diagram of music wire, watch spring wire and tempered spring wire. VSP(10)

Heat-Treatment of Iron Nickel Alloys with Additions. (Thermische Behandlung von Eisen-Nickel-Legierungen mit Zusätzen.) P. CHEVENARD. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Mar. 22, 1930, page 368.

Abridgement of a paper in *Comptes Rendus*, Vol. 189, 1929, page 846, on reversibly changeable alloys. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 800. Ha(10)

Heat Treatment Continues to Advance. HERBERT M. BOYLSTON (Case School of Applied Science). *Iron Age*, Vol. 126, Sept. 11, 1930, pages 691–692.

Use of alloy steels has increased rapidly in last 25 years. Alloy steels are all carefully heat treated. New heat treatments of C steels have been developed with more careful heat control. Continuous normalizing furnaces have created a revolution in sheet steel business. Gives some of the recent papers on the subject with a brief abstract of each. Extensive research on Fe alloy is being made. X-ray spectrometry and radiography have added much to the study of the structure and defects of metals. VSP(10)

The Macrome Process of Steel Treating. *Machinery*, Vol. 37, Sept. 1930, page 52.

A process for increasing the cutting qualities of tool steel. Developed by the Macrome Steel Products, Birmingham, England claims increased life and greater ability to stand up under heavy pressure. Not a hardening process but a treatment added to the usual heat-treatment of steel. Increased life over ordinary steels is 25% for low C steels up to 300% for high speed tools. Process largely secret though it is known to be a low temperature pre-heating of tools in a closed chamber of gas. RHP(10)

Heat Treating Tables. *American Machinist*, Vol. 73, Aug. 28, 1930, page 367.

Gives table of fixed points for thermometer calibration commonly used in the heat treating department. Gives list of substances and temperature in both Fahrenheit and Centigrade of boiling point, melting point and solidification point. Table of drawing bath mixtures gives substances, melting temperature, and range. RHP(10)

Annealing and Quenching of Duralumin. (Remarque sur le recuit et la trempe du duralumin.) M. MATTER. *Revue de Metallurgie*, Vol. 27, Oct. 1930, pages 560–562.

The rate of cooling of duralumin strips 1–20 mm. thick placed on a rack in air was studied. It is inversely proportional to the thickness of specimens. Air cooling is sufficient to cause quenching effect equivalent to water immersion in sheets up to 2 mm. in thickness. Cooling faster than 150°/hr. gives a certain quenching effect. Quenching takes place on cooling to 200° so that it is possible to quench in molten nitrates at that temperature. JDG(10)

Temperature Control for Hardening Furnaces. *Machinery*, Vol. 36, June 1930, pages 768–769.

Apparently the same as "Tempering and Coloring Axes" by Wirt S. Scott. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 428. RHP(10)

What Heat Treatment Has Done for Aircraft Engine Parts. R. R. MOORE (Wright Aeronautical Corp.). *Iron Age*, Vol. 125, Sept. 11, 1930, pages 677–679, 757.

Heat treatment improves the physical properties of metallic alloys. Recent developments of heat treating of Al alloys is responsible for much of the development of the aircraft. Two stages of heat treatment are the solution treatment and the aging treatment. Heat treating Al alloys has resulted in their displacing the heavy bronzes, Fe and steels. Gives tables showing the composition of light alloys and their improvement by heat treatment. Heat treating results are affected by small variations in chemical composition. Where resistance to elevated temperatures is desired, alloys known as "Y" and "Alco 122" are used. Heat treating duralumin, desirable properties are obtained by quenching in oil, air, warm water or cold water. Each of these treatments are adaptable to certain uses. Short-cut heat treatment leads to inferior properties. Aging at lower temperatures for longer periods, better physical properties are obtained. Complete aging produces maximum tensile strength and also considerable increase in proportional limit. Heat treatment has to a considerable extent lightened the construction of steel engine parts. Heat treatments also improve machinability. VSP(10)

Hardening (10a)

Forging Hardened Without Warping. *Iron Age*, Vol. 126, Sept. 4, 1930, pages 626–627, 675.

Describes simple home-made equipment used, which is giving satisfactory results. Carburizing pots are made of 16-in. cast Fe water pipe about 10 ft. long. Furnace is bottom-fired with oil. Six guides are treated at one time. A temperature of 1675° F. is reached in about 12 to 13 hr. firing. Uniform temperature is produced by a series of vents. VSP(10a)

Metal Surface Hardening. A. E. SHORTER. *Welding Journal*, Vol. 28, Nov. 1930, pages 333–340.

Paper before the Institution of Welding Engineers on Nov. 13, 1930. The paper discusses the "Shorter" process for surface hardening of gears, helicals, bevels and a great variety of pieces both as to form and size. The treatment consists of a heating by means of an oxy-acetylene blowpipe followed by a rapid quench. The process is entirely mechanical so that uniform results are obtained. AWM(10a)

Nonferrous Metal Hardening Process. *Brass World*, Vol. 26, Dec. 1930, page 327.

The "Hump" steel hardening process is now applied to Al and brass products. This process requires: a single-point recording potentiometer (or two-point combination recorder and recording controller), an electric furnace with manual control equipment and adjacent tank for quenching. Units are obtainable in multiple formation as well as singly. WHB(10a)

Hardening Tools. *American Machinist*, Vol. 73, Sept. 18, 1930, page 491.

Condensed summary of the fundamental hardening rules and of faults. RHP(10a)

Annealing (10b)

Normalized and Annealed Sheets. R. WHITFIELD. *Heat Treating & Forging*, Vol. 16, May 1930, pages 603–607, 613; Condensed in *Fuels & Furnaces*, Vol. 8, June 1930, pages 801–804.

Paper read before Iron & Steel Institute, May 1–2, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 800. MS(10b)

Changes in Structure of Mild Steel on Annealing. W. HEIKE & W. BRENSCHEIDT. *Iron Age*, Vol. 126, Nov. 27, 1930, page 1605.

Abstract translation of article in *Stahl und Eisen*, Sept. 25, 1930. Annealing of mild steel in oxidizing atmospheres and the decarburization of outer sections is accompanied by formations of columnar crystals pointing from outer layer toward the center. Gives results of tests. See also *Metals & Alloys*, Vol. 2, Feb. 1931, page 40. VSP(10b)

Employs Salt Bath Annealing in Drawing Hollow Wire. *Steel*, Vol. 87, July 3, 1930, pages 62, 66.

Describes practice of Ellwood-Ivins' Steel Tube Works, Philadelphia, in the manufacture of extremely small-sized tubing such as hypodermic needles. Tubular Cr-Mo (S.A.E. 4130 or 4140) billets, 2–3 in. outside diameter, are given 60–75 cold draws, with an anneal before each draw, to reduce the outside diameter to 0.009 in. and the wall thickness to 0.001 in. Annealing is done in a salt bath heated by electrodes immersed in the liquid. The bath is held at 1400° F. before receiving the work. MS(10b)

The Fundamentals of Successful Strip Brass Annealing. CHARLES K. SKINNER (Gen. Elec. Co.). *Metal Industry*, N. Y., Vol. 28, Sept. 1930, pages 420–422.

Confined to annealing in large batch type furnace of the side-top-fired oil burning type. The variables which influence the result of heat treatment of brass are: (1) furnace design; (2) burners; (3) pyrometric equipment; (4) annealing; (5) firing; (6) metal; (7) loading of pans; (8) sampling; (9) time of anneal; (10) fuel. Discusses each. VSP(10b)

Case Hardening & Nitrogen Hardening (10c)

Influence of Nitrogen on Special Steels. S. I. SATOH. *Fuels & Furnaces*, Vol. 8, April 1930, pages 523–526.

From paper read before American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, March 1930, page 429. MS(10c)

Bell-Type Nitriding Furnace Has Been Recently Developed. *Electric Journal*, Vol. 28, Jan. 1931, page 40.

In an electric nitriding furnace, the objects are put inside a stationary box, through which ammonia gas can be circulated by permanent piping, both box and piping being constructed of solid nickel. To make the box gas-tight, the edges of its cover are turned downward dipping in a trough of molten Pb. The Pb is melted by tubular heaters built into the trough. Then, over the box, a crane sets the 7$^1/_2$ ton-bell—heavily insulated and lined with heating elements. Base, box and 3500-lb. charge can be brought from room temperature to 1000° F. in 6 hrs. by the input of 75 kw., 220-volts, 3-phase, after which that temperature can be maintained by only 11.5 kw. In continuous operation, the bell need never get cold, as one bell serves 2 bases and 2 nitriding boxes alternately. WHB(10c)

Annealing or Softening of Nitrided Steels by Chemical Decomposition of the Nitride. W. J. MERTEN. *Fuels & Furnaces*, Vol. 8, Feb. 1930, pages 199–200.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 40. MS(10c)

Drawing (10e)

Carbide Precipitation during Drawing of Corrosion Resistant Non-Magnetic Chromium Nickel Steel. B. STRAUSS, H. SCHOTTKY & J. HINNÜBER. *Metals & Alloys*, Vol. 1, Oct. 1930, pages 785–787.

A translation. Original in *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 188, Mar. 1930, pages 309–324. ESC(10e)

Aging (10f)

Reactions during Age Hardening. (Die Vorgänge bei der Vergütung.) G. TAMMANN. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 365–368.

Tammann discusses the theory of Merica who ascribes the phenomenon of age-hardening to the blocking of lattice planes due to highly dispersed precipitations and the loss of age-hardening to the coagulation of the dispersions. This conception, transferred from the fields of colloid-chemistry, does not suffice for Tammann who supports his statements by mathematical derivations. He assumes in addition to Merica's assumptions that the slip of the dispersions is rendered more difficult in the adjacent parts. A clear atomistic interpretation is not possible at the present time. Tammann discusses the gathering of the excess atoms in super-saturated solid solution resulting in a notable change of properties. This he demonstrates by means of several typical examples taken from chemical and metallurgical fields. The position and form of the dispersion from super-saturated solid solutions exert a large influence upon the increase of strength during age-hardening. The author urges further microscopic examinations of the shrinking needle-like segregations and of their growing, as studied in the case of cementite lamellae, in Ni-Si, Co-Si solid solutions and in Cu-Al alloys. 11 references. EF(10f)

The Aging of a Constructal Alloy. (Ueber die Vergütung einer Constructallegierung.) G. WASSERMANN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 48–49.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 913. (10f)

JOINING OF METALS & ALLOYS (11)

Brazing (11a)

Brazing Operations. A. Eyles. *Brass World*, Vol. 27, Jan. 1931, page 7.

Brazing is preferable to welding for making joints or repairing products made of brass, bronze or malleable iron. Precautions and operations are outlined and the composition of solders for brazing soft and hard brass, copper, iron and steel tabulated. WHB(11a)

Multiple-Joint Brazing in Hydrogen Atmosphere. H. M. Webber (General Electric Co.). *American Machinist*, Vol. 73, Oct. 30, 1930, pages 697–699; Nov. 6, 1930, pages 745–747.

Brazing is very successful. Cu and Fe have a strong affinity for each other at 2100° F. The H atmosphere within the furnace cleans oxide film and some impurities from the surface of the Fe giving a good brazing surface. Maximum tolerance for gap to be brazed is about 0.003 in. Pressure applied to the joint increases strength as the Fe tends to grow together. 4 effects impart strength to a Cu brazed joint, i. e., the alloying of the Cu with the Fe, alloying of Fe with the Cu, penetration of Cu along the grain boundaries, and the grain growth across the joint. The accumulation of these effects produces in most cases a joint as strong as steel itself. Strains seldom result from brazing. Stainless steels cannot be brazed in this way. W, Mo and tungsten carbide alloys may be brazed this way. Gray cast Fe has to be heated in the air to oxidize the surface before putting in the furnace for brazing. Malleable cast Fe is more easily brazed. The second part of the article deals with methods of brazing, equipment, costs, and time required for the work. RHP(11a)

Soldering (11b)

The Composition of Silver Solders. (Die Zusammensetzung von Silberloten.) Ralph J. Snelling. *Deutsche Goldschmiede-Zeitung*, Vol. 33, Nov. 15, 1930, pages 543–544.

Silver solders usually are Ag-Cu or Ag-Cu-Zn alloys. The Zn lowers the melting point, but decreases the strength and ductility. An alloy containing 65% Ag, 20% Cu and 15% Zn melts at 695° C. and has good properties. For use on second quality articles the solder may contain only 25 or 30% Ag. Several percent of Cd can be added to silver solders to advantage. Sn or Ni are also sometimes used. Fe and other impurities should be carefully avoided. JLG(11b)

Welding & Cutting (11c)

Welding with the Electric Arc. (Auftragsschweissung mit dem elektrischen Lichtbogen.) K. Tewes. *Giesserei Zeitung*, Vol. 27, Nov. 1, 1930, pages 585–589.

The author deals in general with the metallurgical and electrical sides of the problem of welding and gives, in the second part of his book, practical results in welding rails. Different types of electrodes were used in the tests; one with the composition, C : 1.10%; Si : 0.25%; Mn : 0.25%; P: 0.04%; S: 0.03%, proved most successful. The author takes his stand against the application of austenitic Mn rails. The use of a Ti steel filling rod is favored. This is abstracted by F. Rapatz in *Stahl und Eisen*, Vol. 50, Oct. 16, 1930, pages 1474–1475. GN(11c)

The Importance of Burning Depth in Arc-Welding and the Means for Its Improvement. (Die Bedeutung der Einbrandtiefe beim Lichtbogenschweissen und die Mittel zu ihrer Verbesserung.) Ernst Schwarz. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1565–1567.

When welding with direct current, the burning depth is influenced by the following conditions: (1) the polarity must be right; welding rods with high C contents should be connected to the positive; (2) welding rods of high C contents have a lower burning depth than those with low C; (3) the burning depth can be increased to a certain degree by a reduction in velocity of advance and an increase of current; (4) a welding dynamo which gives higher current peaks in welding (as shown in an oscillogram) is preferable; (5) the burning depth for butt-welded joints and surface welds should be at least 2 mm.; (6) in V-welds, the burning depth must be at least so great that hollow spaces at the bottom of the angle are avoided. Ha(11c)

Strength and Structure of Welds. (Festigkeit und Gefüge von Auftragschweissungen.) O. Dahl & S. Sandelowsky. *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, pages 1639–1642.

The various applications of welding with a filling rod are described and the results are given of investigations which the authors have carried on with 8 different welding rods. The results of hardness tests and metallographic studies are discussed. GN(11c)

Steel Mill Applications of Thermit Welding. H. Deppeler. *Rolling Mill Journal*, Vol. 4, Mar. 1930, pages 93–94.

Abstract of a paper read before the American Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 387. MS(11c)

Electric Welding as Applied to Railway Bridges and Other Structures. H. Bruff. *Engineering*, Vol. 128, Nov. 22, 1929, pages 687–689; Nov. 29, 1929, pages 719–722.

Condensed from paper read before the Junior Institution of Engineers, Oct. 25, 1929. Points out advantages of repairing worn-out bridges by means of electric welding. Describes actual welding process carried out in attempt to procure data on strength of such welds. Same process has been successfully used for constructing new structures, for making bridge floors watertight, for repairing worn railroad track crossings, and for the repair of worn-out coal spouts. Discusses problem of stress encountered when fluid metal is deposited on material already strained as in case of strengthening weak bridges. See also editorial on page 711 and letter on page 781. LFM(11c)

Progress of Welding Technique in Steel Structures. (Fortschritte der Schweisstechnik im Stahlbau.) H. Schmuckler. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1573–1579.

The safety of welded steel structures is discussed and certain suggestions are offered for improvements in the regulations for welded high structures. A few simple examples of calculations and formulas are given which can serve as a basis for calculaton. A new simple arrangement is described and a table is given on which the structural steel parts can easily be put together for welding. Illustrations of actual constructions are reproduced. Ha(11c)

Strength Investigations on Welded Beam Connections. C. H. Jennings & A. A. Jakkula (Westinghouse Elec. & Mfg. Co.). *Journal American Welding Society*, Vol. 9, July 1930, pages 64–70.

Discussion of paper read before the annual meeting of the American Welding Society. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 692. LFM(11c)

All-Welded Barge. E. H. Ewertz. *Journal American Welding Society*, Vol. 9, July 1930, pages 70–72.

Discussion of paper read before the annual meeting of the American Welding Society. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 692. LFM(11c)

The Theory of Stresses in Fillet Welds. L. C. Bibber (U. S. Navy Dept.). *Journal of the American Welding Society*, Vol. 9, July 1930, pages 7–13.

Discussion of paper read before the annual meeting of the American Welding Society. See *Metals & Alloys*, Vol. 1, July 1930, page 631. LFM(11c)

Electric Welds in Mild Steel. (Sur les soudres enacier doux déposées à l'arc électrique.) D. Rosenthal & M. Mathieu. *Comptes Rendus*, Vol. 191, Sept. 22, 1930, pages 484–486.

Impact tests have shown that the brittleness of welds in mild steel depends to a large extent on the manner in which the metal is protected against atmospheric oxidation during fusion. Authors have tested welds made (a) with bare wires, and (b) with coated wires, with the following results:

Electrode	No. of Sample	Section at bottom of notch in cm.²	Impact number kgm/cm.²	Remarks
Bare mild steel wire	113 B1	0.485	0.82	Crystalline fractures
	113 B2	0.49	0.81 (5)	
	113 B3	0.5	1.0	
	113 B4	0.47	0.96	
Ordinary coated electrode	T2–1	0.51	7.60	Fractures fibrous, slightly crystalline at centers
	T2–2	0.47	7.55	
of good quality	T2–3	0.5	6.80	Fractures fibrous, crystalline at centers
	T2–4	0.48	5.85	

The table emphasizes the great difference in the resistance to impact of welds made with the 2 types of electrode. Micro-examination showed that the use of coated electrodes resulted in structures more regular in appearance, than those obtained with the bare wires, but threw little more light than this on the matter. Examination of the welds under the K-indication of a molybdenum anti-cathode resulted in diagrams differing quite markedly in appearance. The diagrams from the bare wire welds sometimes indicated slight orientation and in all cases showed very pronounced asterism. These from the coated electrode welds showed no evidence of orientation and but slight signs of asterism. Conclusion is that the existence of internal stresses in the welds made with uncoated electrodes is thus made manifest. OWE(11c)

Riveting (11d)

How Riveting is Keeping Pace with Advance in Industry. A. F. Jensen (Hanna Engineering Works). *Iron Trade Review*, Vol. 85, Nov. 28, 1929, pages 1379–1381.

From paper read before American Institute of Steel Construction, Nov. 14, 1929. Gives several examples of speeding up driving of rivets in all types of construction by means of new equipment. Cold driving is gaining favor. Advocates a thorough investigation of stresses in rivets to bring information up to date. Outlines a program of research. MS(11d)

Riveting in Metal Airplane Construction. (Nietverfahren in Metallflugzeugbau.) Wilhelm Pleines. *Luftfahrtforschung*, Vol. VIII, Apr. 1930, pages 1–72; translated in *National Advisory Committee for Aeronautics Technical Memoranda* Nos. 596, 597, 598 and 599, Dec. 1930.

The articles describe in detail the procedure and practice used in Germany for designing and manufacturing riveted joints for airplanes. The rivets are generally used with aluminum alloys (duralumin) and are manufactured of a similar material. The sizes vary from $^1/_{16}''$ to $^5/_{16}''$ in diameter. All rivets are driven cold. There are many descriptions and illustrations of apparatus and joints used by the leading airplane builders, Junkers, Rohrbach and Dornier. Ingenious dollies and jigs are used for backing up rivets inside of tubes and hollow members. Press and machine riveting is used wherever possible. The eccentric press, maximum 13,000 lbs., requires a rivet $^1/_{16}''$ to $^3/_{32}''$ longer than a hand driven rivet. The diameter of the hole for machine driven rivets is 0.010″ and for hand driven 0.004″ larger than the rivet shank. Special devices are attached to the machine to prevent thin sheet from crimping at the rivet hole and to guide the rivet during driving so that it will not become cocked. Riveting by compressed air hammers involves a danger from the dolly recoil damaging the sheet. (American manufacturers use air hammers as much as possible, as approximately 8 rivets can be driven by this method to one by hand.) American devices for absorbing the shock of riveting are referred to, Junker uses an automatic time release and an air closing device with foot lever operation. The quality of riveting is determined by visual inspection of the rivet heads and determination of the thickness of the driven head by gages. Illuminated mirrors are used for the inside of tubes and similar members. Each manufacturer uses his own rivet standards. References made to S.A.E. standardization of duralumin rivet heads in the United States. The tolerances permissible for the diameter and length of the shank are given. Rivet head eccentricity is held to 5% of the body diameter with 0.013″ as maximum. Stock rivets over 0.4″ in length are graded for every 0.08″ although there is a demand for 0.04″ gradation. Rivets are heated at 500° to 520° C. (930° to 968° F.) from 10 to 15 minutes. Method of quenching not given. For emergency repair 420° C. (788° F.) is used as the rivets can be driven at any time, whereas the higher temperatures cause age hardening and the rivets can only be used up to 5 hours. The standard formulas for design of joints are given. The methods of determining allowable stresses for riveted steel structures does not apply as there is no well defined yield point in duralumin and to use the factors used for steel would increase the weight of the structure more than necessary, as demonstrated by actual service. A shearing strength for the rivet of from 35,000 to 38,000 lbs./in.² is recommended for design. The shearing strength depends upon the method of driving.

Average Shearing Strength of Duralumin Rivets in lbs./in.²

Plain	Hand Driven	Machine Driven
Not Driven	7 oz. Hammers 16–18 Blows	Eccentric Press, 13,200 lbs.
31,500	37,000	47,000

The allowable stress for the crushing of duralumin sheet at the edge of the rivet hole is 85,000 lbs./in.² Tests indicate much higher values before failure but the enlargement of the hole is considerable at even lower stresses. The crushing strength of the thin plates less than 0.04″ in thickness was lower than the thicker plates with a steel bolt through the rivet hole, but when tests were made on driven rivets the heads supported the thinner sheets so that the crushing value was equal to that of the thicker sheets. When the distance from the edge of the hole to the edge of the plate exceeds 2 times the hole diameter the crushing strength is constant and equal to approximately 160,000 lbs./in.² The application of a tensile or compressive stress to a riveted joint extends the hole in the direction of the load. The allowable amount of extension is problematic and can only be settled by a series of alternating impact tests as it is under this type of loading that the hole enlargement has a serious weakening effect. A hole enlargement of 1% is obtained with crushing values of from 47,000 to 65,000 lbs./in.² The enlargement of the rivet hole by expansion of the rivet shank when the rivet is driven lowers the resistance to crushing and must be guarded against, especially on thin sheets. JBJ(11d)

The DeBergue Patent Countersunk Riveting Process. *Sheet Metal Industries*, Vol. 4, Oct. 1930, pages 458–460.

The process is suggested for sheets up to $^1/_8$ inch thick. The company prefers to limit mild steel sheets to 14 gage. The process yields a joint in thin metal with one surface flush and possessing about twice the strength of a standard joint with ordinary cup-head rivets. The sheets are interlocked so that they cannot slide and the shear stress is therefore removed from the rivet shanks. AWM(11d)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Study on Basic Open-Hearth Slags and Their Charting. *Iron Age*, Vol. 126, Oct. 23, 1930, page 1159.

Taken from a paper read at the British Iron and Steel Institute meeting in Czechoslovakia by Otakar Quadrat on "A Contribution to the Problem of the Analysis of Basic Slags and the Representation of Their Composition in a Triangular Diagram." Proposal of a method for showing by diagram the characteristics of a basic slag. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. (12a)

Melting Steel in a Brackelsberg Furnace with Acid Lining. P. BARDENHEUER. *Foundry Trade Journal*, Vol. 43, Oct. 23, 1930, pages 285–286; *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1049–1054, 1114.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 42. MS(12a)

"Two Speed" Melting Shop Management—or Steady Average. WALTER LISTER. *Metallurgia*, Vol. 3, Nov. 1930, pages 1–3, 8.

In steel melting practice it is uneconomical to attempt to make record production if such speed necessitates extensive repairs. Describes correct melting practice and management in detail. JLG(12a)

Making Malleable Iron by the Duplex Melting Process. B. R. MAYNE. *Fuels & Furnaces*, Vol. 8, June 1930, pages 783–786.

From paper read before the American Foundrymen's Association, May 12–16, 1930. MS(12a)

Advice on Fluxing Aluminum. *American Metal Market*, Vol. 37, No. 240, Dec. 13, 1930, page 4.

A bulletin by the National Smelting Co. discusses the fluxing of aluminum. A good flux for aluminum melting should contain 2 salts—one with a low melting point and the other with a high one to retard the thermit reaction when it becomes too rapid. For large furnace operation other fluxes have been developed. The flux should be of low specific gravity, and should not pick up moisture when stored. WHB(12a)

Favors Electric Furnaces for Special Steels. *Electrical World*, Vol. 96, Dec. 27, 1930, page 1184.

Electric furnace operation is closely controlled yet flexible and excludes oxygen from the melting process. The Chicago Steel Foundry Co. manufactures "Pyrasteel" designed for high temperature uses and "Evansteel," made in various grades of hardness, tensile strength and elastic limit. Both steels are classed as Ni-Cr alloys. The electric furnaces used are both of the open-roof type. The general features of the 2 furnaces are indicated by pictures and drawings. WHB(12a)

Preventing Unsoundness in Bronzes and Red Brass. *Foundry*, Vol. 58, Aug. 1, 1930, pages 84–87, 109.

Metals having good fluidity, low contraction, pour clean and are not greased easily, are easiest to cast sound. Greatest difficulty encountered in production of sound bronze and red brass castings, including Cu-Sn, Cu-Sn-Zn and Cu-Sn-Zn-Pb alloys is trouble from internal sponginess or porosity. Porosity in bronzes and red brasses has been attributed to oxidized metal. Reducing atmospheres have a deleterious effect on the metal and may produce incipient shrinkage in some bronze alloys. Considers operating characteristics of several commercial furnaces, reactions of gases on Cu and structural characteristics of the alloys. Typical combustion reactions of the various gases are:

$$CH_4 + 4O = CO_2 + 2H_2O + \text{Heat}$$
$$2CO + O_2 = 2CO_2 + \text{Heat}$$
$$2H_2 + O_2 = 2H_2O + \text{Heat}$$

An oxidizing atmosphere may consist of 4% O, 13% CO_2 and remainder N. Neutral melting atmospheres necessitate proportioning burners which maintain ratio of fuel to air constant. VSP(12a)

Open-Hearth Operators Discuss Basic and Acid Practice. *Iron Trade Review*, Vol. 86, May 29, 1930, pages 54–55.

Report of the 11th semi-annual meeting of the open-hearth committee of the American Institute of Mining & Metallurgical Engineers, May 21–23, 1930. MS(12a)

Fabrication of the Platinum Metals. C. S. SIVIL (Baker & Co.). *Preprint, American Institute of Mining and Metallurgical Engineers*, 1931, 15 pages.

Platinum was formerly fabricated by hot forging of the sponge, and this method is still used to a limited extent in Europe. It can be melted in the oxyhydrogen flame, arc furnace, induction furnace or by the atomic hydrogen torch. Hydrogen hardens, but does not prevent working. Gases, particularly oxygen, affect the properties. Carbon is very deleterious. Lime is the most generally used refractory for melting Pt. Both Pt and Pd can be easily worked either hot or cold. The softening temperature for cold worked Pt is 650° C. In making wire Pt or Pd are either rolled or swaged to bars suitable for drawing in tungsten carbide dies. Bare wire can be drawn as fine as 0.0004 in. Rhodium can be worked with difficulty. Iridium is even more difficult to work. Ruthenium and Osmium have not been worked. Contains 15 references. JLG(12a)

Investigation of the Thomas Process. (Untersuchungen über die Vorgänge beim Thomasverfahren.) KURT THOMAS. *Stahl und Eisen*, Vol. 50, Nov. 27, 1930, pages 1655–1674; Dec. 4, 1930, pages 1708–1718.

Report 196 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The investigation was undertaken to determine the influence of the shape of the converter on the process of blowing, i. e., on the time of blowing, the metal loss through oxidation and mechanical causes and the increase of temperature of the charge. About 50 heats were tested to establish the above relations For this purpose, during the course of one campaign, the weight of the charge was changed to obtain similar conditions as regards the height of the bath in the converter and the converter volume available/ton of input. The results confirm the known fact that a high charging temperature of pig Fe is favorable; a minimum temperature of 1250° C. should be used. No reliable relations could be established between time of the blow and height of the bath, air volume and pressure, and converter volume/ton of the charge. It is shown, however, that the time of blow is essentially decreased when the "cross-section of circulation"/ton of the charge is increased. The "cross-section of circulation" (Umlaufsquerschnitt) is defined as the relation between the cross-section of the bath and the cross-section of blow. The time of the blow could be reduced by 20% when the "Umlaufsquerschnitt" was increased from 1100 to 2400 cm.²/ton of charge. This also resulted in a decrease of the mechanical metal loss. The time of blow of cold charges is influenced more by the "Umlaufsquerschnitt" than that of hotter charges. The large "Umlaufsquerschnitt" has no unfavorable bearing on the increase of the temperature during the blow. It is concluded that the amount of CO_2 of the waste gases increases with increasing "Umlaufsquerschnitt" which was proven by investigating the air consumption/kg. of additional elements. GN(12a)

Debismuthizing Lead with Calcium. RALPH F. COHN. *American Electrochemical Society, Preprint* 59–2, April 1931 Meeting, 6 pages.

Desilverized lead containing 0.1% Bi is not suitable for white lead manufacture. The Betts' electrolytic lead process for the elimination of the Bi is applicable, but the new process herewith presented is more economical. Metallic Ca is introduced into molten Pb. A Ca-Bi dross is formed. The Bi in the Pb is reduced to less than 0.05%, and the last traces of As, Sb, Ag and Cu are scavenged. The slight excess of Ca remaining in the Pb is removed with Cl. The dross is submitted to the Betts' process. The theory and economics of the new process are discussed at length. (12a)

Production and Remelting of Brasses. EDMUND R. THEWS. *Metal Industry*, London, Vol. 37, Sept. 12, 1930, pages 241–242; Sept. 26, 1930, pages 293–294, 296.

Prevention of the loss of large percentage of Zn by oxidation has been reduced to about ½% or less by the introduction of the electric furnace. In melting and remelting brasses following types of furnaces are used: (1) reverberatory furnace (coal, gas and oil); (2) Crucible furnace (coal, gas and oil); (3) electric furnace (electric arc and induction type). A correctly built brass melting furnace should fulfill following requirements: (1) loss of Zn by oxidation should not exceed 1½% with crucible furnaces and ½% with electric furnaces; (2) remelting brasses should not cause the mechanical and chemical properties of the alloys to deteriorate; (3) furnaces should possess as large a productive capacity as possible. Effect of SO_2 and superheat is injurious. Excessive loss of Zn may also be prevented by protecting surface against oxidizing influence of air. Addition of Al and Mg has unfavorable influence on mechanical properties and on appearance of metal surface. Electric brass melting furnaces will give best results obtainable. Recovering flue dust and heat distribution and control are discussed. VSP(12a)

The Influence of Solid and Liquid Pig Iron on the Operation of the Open-Hearth Furnace. (Einfluss von flüssigem gegenüber festem Roheisen-einsatz auf die Betriebsverhältnisse im Siemens-Martin-Werk.) F. WEISGERBER. *Stahl und Eisen*, Vol. 50, Oct. 23, 1930, pages 1489–1495. 3 references.

Report 194 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. 20–30% of liquid pig iron in the charge of the open-hearth furnace increase the furnace output by about 10%, decrease the consumption of pig iron by 10% and the fuel consumption by about 15%. The lime consumption decreases somewhat, whereas the consumption of dolomite increases to a certain extent. Liquid pig iron does not impair the quality of the steel. Considered from the economic point of view, the use of liquid pig iron offers only advantages. GN(12a)

Bath Reactions in Pulverized Coal-Fired Air Furnace. E. F. WILSON. *Fuels & Furnaces*, Vol. 8, June 1930, pages 857–858.

From paper read before the American Foundrymen's Association, May 12–16, 1930. MS(12a)

The Relation between the Manganese Contents of Liquid Steel and the Slag. (Die Beziehungen zwischen den Mangangehalten des flüssigen Eisens und der Schlacke.) H. SCHENCK. *Stahl und Eisen*, Vol. 50, Sept. 25, 1930, pages 1363–1364.

Abstract of a paper by G. Oishi presented before World-Engineering Congress, Tokyo, Oct. 1929. In order to establish the above relations, the author evaluated the analytical results of a group of laboratory tests as well as the results obtained on acid and basic open hearth melts. In determining the equilibria, 30–50 g. of electrolytic Fe were melted in porcelain crucibles, to which small amounts of silica, manganese oxide and ferrous oxide were added. In a further group of tests, the conditions of equilibrium were changed by adding lime to the slag. After melting, metal and slag were subjected to a temperature of 1550° C. for 3 to 10 min. The results of 2 acid and 2 basic heats are described in some detail. The relation of the total concentration of MnO and FeO $\frac{(\Sigma\ MnO)}{(\Sigma\ FeO)}$ is plotted in diagrams against the Mn content (Σ N Mn) of the steel. This relation holds providing the Mn content does not exceed 0.3%. GN(12a)

American Investigations on the Physical Chemistry of the Steel Processes. (Amerikanische Forschungsarbeiten über die physikalische Chemie der Stahlerzeugungsverfahren.) H. SCHENCK. *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1782–1786.

Critical review of the latest publications by C. H. Herty. GN(12a)

Progress in Basic Open-Hearth Practice. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 114–115.

Quality steel is being produced under quantity conditions through better operating practice. Open-hearth charge, proper slag condition, quality fuel, etc. are important factors in making good steel. If steel is not clean at tapping, adding deoxidizers afterward will not improve the quality. Hennig Purifier is claimed to be beneficial, as it degasifies and desulphurizes the metal. By taking proper care of molds, better surfaced ingots are produced. MS(12a)

Economics of the Various Refining Agents in the Open Hearth Process. (Untersuchung über die Wirtschaftlichkeit verschiedener Frischmittel für das Siemens-Martin Verfahren.) S. SCHLEICHER. *Stahl und Eisen*, Vol. 49, Apr. 4, 1929, pages 458–464.

Report 162 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The decarburization of a steel bath by adding ore was studied to determine the economics of various refining agents. The results show that the decrease of C in the bath is approximately a linear function of the time. The O content has no bearing on the velocity of refining. However, it determines the amount of the refining agent to be used. The Si content is of importance inasmuch as it regulates the amount of CaO to be added and the loss by oxidation. It is shown that, based on the chemical analysis of the refining agent and its price, its economical use can be calculated in advance, due to the above mentioned linear function of the decrease of C. In the case that larger amounts of ore are added than are necessary to oxidize the amount of C in a certain short time interval, part of the Fe content of the ore is slagged. GN(12a)

The Composition of Basic Open Hearth Slags. (Gesetzmässigkeiten in der Zusammensetzung basischer Siemens-Martin Schlacken.) S. SCHLEICHER. *Archiv für Eisenhüttenwesen*, Vol. 4, Nov. 1930, pages 239–244; *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1778–1779.

The relations between the various components of basic open hearth slags have been established in examining 29 slags. The amount of MnO is lower in higher basic slags than in less basic slags. The Fe content of slags decreases with increasing acid components. The amount of MnO varied between 27.95 and 12%. The average total amount of MnO, CaO and MgO in the 29 slags analyzed is 61.4% which indicates that CaO and MgO can be replaced in basic slags by MnO. It is furthermore shown that there exists a relation between the Fe content and the content of SiO_2 and P_2O_5. The Fe content of the slags decreases with increasing amount of SiO_2 and vice versa. The above relation holds for the slags of low C steels up to 0.20 C. In slags of higher C steels the total of MnO + CaO + MgO amounts to about 65.5%; but the relation between MnO and CaO and MgO is preserved. By determining only the Mn and Fe content of a basic open hearth slag, the theoretical analysis can be approximately calculated. GN(12a)

The Open-hearth Steel Process as a Problem in Chemical Kinetics. ERIC R. JETTE (Columbia University). *Technical Publication* No. 380, *American Institute of Mining and Metallurgical Engineers*, 1931, 34 pages.

Complete knowledge of a chemical process requires not only an understanding of the thermodynamics of the reactions, but also a knowledge of the mechanism and kinetics. An attempt is made to develop an equation for the kinetics involved in the steel making process. The mechanism is not certain, but the most probable assumption is that it can be explained by the equation $FeO + C \rightleftharpoons Fe + CO$. On this basis an equation is developed and critically discussed. It is probable that the rate of diffusion of FeO from slag to metal is a governing factor, and this rate is very difficult to predict. As long as open-hearth heats are finished with oxidizing slags the steel will be overoxidized. Contains 17 references. JLG(12a)

Rolling (12c)

Modern Chilled Iron Rolls. W. H. MELANEY. *Rolling Mill Journal*, Vol. 4, Apr. 1930, pages 143–144, 153–154; May 1930, pages 237–240; June 1930, pages 291–293; July 1930, pages 371–373; Sept. 1930, pages 469–470, 473–474.

Face of chilled rolls has a hard, white, brittle crystalline structure, all of the C being in the combined state. Center consists of a dark gray granular formation in which there is a net-work of combined C filled in with specks of graphite. This has the hardness of ordinary cast Fe. Between the face and center there is a formation, known as "spray," which has an appearance and characteristics half-way between those of the other 2 structures. Rolls become convex during rolling due to the uneven expansion of the middle and ends. To correct this, the roll face parallel is made slightly concave. The hotter the roll is operated, the greater the concavity required. The harder the face and the greater the depth of chill, the greater will be its expansion at a given temperature. The longer a roll has been in service, the less will be its expansion under the same conditions. Expansion of center of roll is only about half that of face. This difference causes stretching of the center and, if heating is rapid, rupture with eventual breakage of the roll in service. By selecting rolls with a hardness just sufficient to give the surface desired, danger of breakage will be reduced. Mild-chilled faces are applicable to right-pack rolling. For highly finished surfaces, hard-faced rolls are used at relatively lower temperatures. The rolls must be preheated slowly to their rolling temperature before the work is started. Preheating time is determined largely by the mass of the roll. Diagonal breakage is usually due to deep chill or to a close spray extending quite a depth into the body of the roll. The harder the roll, the more susceptible it will be to this type of breakage. Roll failure may be caused by spalls, due to excessive pressure arising from such conditions as having the screws forced down too tightly and accidental rolling of cold material. If rolls become concave during service, it will usually be found that the necks are becoming too hot, from lack of lubrication, insufficient bearing area or the lifting of the necks clear of their bearings by the wedge action of the fillets caused by the rolls having become too tight endwise. A slight tapering of the necks is advantageous. Usual condition during rolling is for face to become convex. Proper use of steam on center of face will remedy this. MS(12c)

Scleroscope Hardness of Chilled Rolls. W. H. MELANEY. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 100–101.

Hardness of face of a roll should be based on type of work to be produced. Where tail marks cannot be tolerated, it is necessary to have a harder face than in other cases. A roll should not be harder than is essential for proper results, due to the greater expansion and greater liability to breakage of hard rolls. The scleroscope has been suggested as an instrument for determining the proper hardness. However, scleroscope hardness is no criterion of the performance of a roll, and, in fact, is often misleading. The physical structure of the roll body beneath the chilled surface, and the depth of chill are the important factors in determining the service obtainable from a roll. MS(12c)

Improved Method of Piling Cold Rolled Sheets. *Rolling Mill Journal*, Vol. 4, March 1930, pages 95–98; *Iron Trade Review*, Vol. 86, March 20, 1930, pages 52–53; *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 646–647.

Description of a tin-plate piling machine, which is substantially automatic in operation. It was developed by the American Sheet & Tin Plate Co. Construction features include runout, edging, and incline conveyors, positioning fingers, and hydraulically spotted transfer car. MS(12c)

The Filling of Passes in Rolling Steel. (Das Füllen der Kaliber.) W. TAFEL & G. WAGENER. *Stahl und Eisen*, Vol. 50, Jan. 30, 1930, pages 126–128.

The authors reply in this paper to Eklund's method of calculating the height of an ingot or billet required to fill the pass and show, by carefully checking this method with the one which Tafel has developed, that though both methods are equally simple, Tafel's method is superior owing to a greater accuracy. GN(12c)

Roll Pass Design. Pt. XIII–XXIV. W. TRINKS (Carnegie Institute of Technology). *Rolling Mill Journal*, Vol. 4, Jan. 1930, pages 15–18, 25–26; Feb. 1930, pages 49–53; Mar. 1930, pages 103–106; Apr. 1930, pages 139–142; May 1930, pages 241–244; June 1930, pages 295–296; July 1930, pages 359–360, 378; Aug. 1930, pages 415–416; Sept. 1930, pages 465–468; Oct. 1930, pages 549–552; Nov. 1930, pages 615–617; Dec. 1930, pages 665–668, 672.

Deals with methods of overcoming effects of non-uniform reductions in the rolling of non-symmetrical sections; conditions which cause fins and over fills and methods of avoiding them; amount and effect of wide work due to edging and to flange rolling; methods of avoiding trouble in rolling flanged sections; effects of live passes and dead holes on side work; factors affecting the magnitude of side pressure for rectangular and wedge-shaped passes; causes and effects of thrust in symmetrical and non-symmetrical roll passes; calculation of end thrust; method of determining bearing area which takes end thrust due to rolling in non-symmetrical passes; application of interlocking collars to rolls for taking up end thrust; bending of a section by rolls or guides; influence of difference in roll diameters on prevention of collars and protection of table rolls; action of forces when diameters differ; roll length; arrangement of passes on rolls; pass design for performing slitting operations in various types of sections in hot rolling; and rolling of square or nearly square sections in blooming-mill passes. MS(12c)

Forces Acting on Roll-Neck Bearings. W. TRINKS & J H. HITCHCOCK. *Iron Age*, Vol. 126, Dec. 4, 1930, pages 1677–1679, 1748.

Abstract of a report of the special research committee on heavy-duty antifriction bearings, read before the Iron and Steel Division of the American Society of Mechanical Engineers. In anti-friction bearing design the accurate average load and approximate maximum load must be known. Average pressure in hot rolling depends on temperature, composition, compression rate, internal friction and friction between bar and rolls; in cold rolling on elongation, compression rate, composition of bar, modulus of elasticity of roll and internal friction of bar. VSP(12c)

Anti-Friction Bearings in the Equipment for Making Wire. F. WALDORF (Timken Roller Bearing Co.). *Wire & Wire Products*, June 1930, pages 223–224, 242–244; July 1930, pages 270–271.

The author gives an illustrated description of roller bearings on roughing and finishing stands, drawing blocks, stranders and other machines. GN(12c)

New Forms of Bearings for Rolling Mills. (Neue Gleitformenlager in Walzwerken.) H. WEINLIG. *Stahl und Eisen*, Vol. 49, Oct. 31, 1929, pages 1573–1579.

Report 71 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The paper reports the results of investigation of new forms of rolling mill bearings carried on by the Röchling Iron and Steel Works at Völklingen, Saar district. Before referring to the results of tests with hard wood bearings, the disadvantages of antifriction bearings are outlined. Among them are especially mentioned the high first cost and the high cost of maintenance. The successful application of the new bearing depends on the quality of the wood used. Detailed information on the determination of the quality of the wood is given. The new bearing has been successfully applied in various rolling mills. Lignum vitae seems to be the most satisfactory wood for the purpose. Comparative tests with bronze bearings, plain wood bearings and the new chambered bearings show a greatly increased rolling tonnage in the case of the last mentioned type. GN(12c)

Forging (12d)

Higher Quality Locomotive Forgings. W. J. KNIGHT. *Railroad Herald*, Vol. 34, Feb. 1930, pages 27–29.

A discussion of the factors affecting construction of high-quality locomotive forgings and of steel composition. Considers the method of heat-treating all steels after they have been shaped by forging. (12d)

Manufacture of Bolts & Nuts. E. J. WILEY. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 45, 1929–30, pages 49–59.

Includes discussion. Elementary exposition of British methods of manufacture. The British have to use slow methods for Whitworth head bolts because these contain more metal in the head than can be upset in one blow without buckling. HWG(12d)

Compressed Air for Forge Hammers. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 985–988.

Discusses the advantages of air over steam and presents information on various plants using compressed air. MS(12d)

Power Control in Hydraulic Forging. VICTOR TATARINOFF. *Heat Treating & Forging*, Vol. 16, March 1930, pages 321–324.

Discusses certain important factors in obtaining the greatest possible economy of production in a hydraulically operated forging plant. These are reduction of water leakage in hydraulic machinery and piping; reduction of water pressure losses in the pipe-line; proper utilization of pumping plant in close accordance with actual water consumption by presses; and stopping the pumps when no press is working. MS(12d)

On the Hot and Cold Working of Austenitic Nickel Steel and Transformer Iron. (Ueber die Kalt und Warmverformung von austenischem Nickelstahl und Transformereisen.) F. SAUERWALD, F. FLEISCHER, A. FISCHNICH & A. RADEMACHER. *Archiv für Eisenhüttenwesen*, Vol. 3, Nov. 1929, pages 365–368; *Stahl und Eisen*, Vol. 49, Dec. 12, 1929, page 1799.

The capacity of strain hardening and the velocity of recrystallization of an austenitic 25% Ni steel and a 4% Si transformer iron was studied on rapid working at various temperatures. These 2 materials were chosen to study the strain hardening in steels which contain either the α-iron or the γ-iron stable over a wide temperature range. The relation between specific deformation work and temperature was established by determining the Brinell hardness after the specimens had been subjected to quick deformations under a drop hammer. The results show that, in rapid working, strain hardening is apparent in Ni steel for temperatures up to 900–1000° C. Strain hardening no longer appears at these temperatures in the transformer iron. Spontaneous crystallizations during the performance of work appear in the Ni steel between 900° and 1000° C.; in the transformer iron at 1000° C. Both steels show a maximum of the strain hardening in the range of blue brittleness. Furthermore, there exists a temperature range within which the work of displacement does not, or only slightly, decreases with the temperature. This observation in Ni steel must, probably, be related to peculiarities of the temperature dependence of the hardness of pure Ni which, evidently has a blue brittleness range, also. GN(12d)

Shearing & Punching (12e)

Determination of the Capacity of a Shear of a Merchant Mill. (Ermittlung der Leistung einer Teilschere an einer Feineisenstrasse.) H. ZIMMER. *Stahl und Eisen*, Vol. 5, Dec. 11, 1930, pages 1751–1752.

The capacity of a shear of a merchant mill was investigated to determine to what extent the shear may decrease the production capacity of the mill. Diagrams are shown to illustrate the findings. GN(12e)

Metal Working in Power Presses. E. V. CRANE (E. W. Bliss Co.). *Preprint, American Institute of Mining and Metallurgical Engineers*, 1931, 31 pages.

The operations in a punch-press may be grouped according to whether the metal is sheared, bent, drawn or squeezed. These operations are analyzed in detail. The deformation in presses is discussed in relation to the tensile values. JLG(12e)

Extruding (12f)

Extrusion of Bismuth Wire. J. G. THOMPSON. *Metals & Alloys*, Vol. 1, Nov. 1930, pages 826–827.

Bismuth wire is produced in single pieces up to 20 ft. in length by means of an extrusion press which is described in detail. 3 dies with orifices, respectively, 0.012, 0.025, 0.031 in. in diameter were used and successful operation was obtained only when the press was charged with a single sound piece of bismuth. The pressure necessary for extrusion depends upon the dimensions of the die and upon the temperature. The properties of the wire vary with the diameter and the conditions of extrusion. In general the wire is flexible enough and has enough tensile strength to be formed in a coil of comparatively small radius but will break if bent too rapidly or at too acute an angle. ESC(12f)

Machining (12g)

How to Drill High-Manganese Steel. *Machinery*, Vol. 36, Aug. 1930, pages 978–979.

High-manganese steel generally contains 10–15% Mn, 1–1.5% C and small amounts of Si, P and S. These steels can be drilled with "Hercules Major" drills made by Whitman & Barnes, Inc., Detroit, Mich. For best results, the drilling machine must have positive feed and powerful drive. Drill point should be warmed before using. In some cases, the Mn steel should be heated to 400° or 500° F. The peripheral speed of the drill should be 12–15 ft./min.; feed between 0.003 and 0.010 in./rev. Do not use coolant or lubricant. A continuous cut should be made. Deep holes should sometimes be drilled in 2 operations, allowing the metal to cool between cuts. RHP(12g)

Carboloy Tools at the White Motor Plant. *Machinery*, Vol. 36, Aug. 1930, pages 980–982.

Carboloy has been used as a tool in about 300 different operations by the White Motor Co. Materials cut are cast Fe, malleable Fe, gun Fe, aluminum bronze, brass, Al and in a few cases steel. Accurate check is kept of each tool. Production increasing in machining cast Fe has been from 30 to 40%; for steel drums 17%. In cylinder bores the best tools formerly made 8 cuts before sharpening, with carboloy 1000. Total life of former tools 240 facings, carboloy 30,000. Total former tool cutting cost was $981.50 as against $37.50 at present. Former tool cost per set $18.00 is now $227.00 for carboloy, yet annual tool cost is $750.00 less than before due to longer life of carboloy. Cutting speeds have been increased. Gives directions for use of carboloy tools. Results obtained have exceeded expectations. RHP(12g)

Making Little Ones Out of Big Ones. *American Machinist*, Vol. 73, Sept. 25, 1930, pages 499–502.

A symposium on methods of breaking up long, heavy chips incident to the use of tungsten-carbide cutting tools. Brief articles regarding this question are submitted by Charles R. Whitehouse, Arthur Bramwell, Martin H. Ball, James R. Cornelius and Roger D. Prosser. Various methods are suggested, including method of grinding tool to curl chip, and an idle revolution or part of one for each cutting revolution. RHP(12g)

DEFECTS (13)

Chipping of Square Billets by Machine. *Rolling Mill Journal*, Vol. 4 July 1930, pages 361–362.

Billet peeling machine of the planer type has recently been designed. Incorporates unusual sensitivity and ease of control which permits the cutting tool to follow the camber as well as any crack in the billet in any direction with almost the same ease as if the cutting tool were directly in the operator's hand. It has peeled billets 6 in. square and 10 ft. 6 in. long in 12 min., including setting-up and removing time. MS(13)

A Sand Cast Test Bar for Specification Purposes for Aluminum Alloy Castings. S. L. ARCHBUTT (National Physical Laboratory, England). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 273–276.

Suggests casting a separate test bar 1" diameter, 7 or 8" long in a 2" diameter sand-lined steel tube with 1/2" sand lining (green or dry) standing on a sand base, inclined 30° to the vertical and top-poured. It has so far been tested on Y-alloy only. This is claimed to show the tendency of the metal toward porosity and pin-holing, better than other test bars. HWG(13)

CHEMICAL ANALYSIS (14)

Improved Technic for the Qualitative Micro-Analysis of the Silver Group. A. BENEDETTI-PICHLER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, pages 309–311.

Presented before the Atlanta Meeting of the American Chemical Society, Division of Physical and Inorganic Chemistry, April 1930. The method is an attempt to improve Schoorl's method by working with capillary tubes and centrifuge cones. The experimental procedures are outlined and some of the micro-tubes and other devices illustrated. MEH(14)

Spectroscopic Analysis of Metals. D. M. SMITH. *Bulletin British Nonferrous Metals Research Association*, No. 28, 1930, pages 7–14.

A lecture discussing the production of a spectrum and the results which can be obtained by spectroscopic examination of metals with particular reference to some recent developments. (14)

Evaluation of Stibnite. II—Determination of Antimony. WALLACE M. MCNABB & E. G. WAGNER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, pages 251–256.

The titrations of trivalent antimony by bromate, iodine, or permanganate, under properly adjusted conditions, yield practically identical results. In presence of ferrous iron the titration of trivalent antimony with iodine in a solution buffered with bicarbonate, is affected by a negative error. A method for determining iron present as impurity in stibnite is described. The Frankford Arsenal method for determination of antimony in stibnite was found to yield results about 0.5% too low. The evolution procedure has been extended to include both the iodometric determination of sulphide sulphur and the titration of antimony with permanganate, analysis for both being made on a single sample. 44 references are cited. MEH(14)

Use of Tantalum as Cathode for the Electrodeposition of Copper. B. MEARS & P. R. PINE. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, page 298.

The authors use a 1:1 aqueous solution of ammonia (sp. gr. 0.90) made 10% with respect to trichloroacetic acid. Ten consecutive depositions of copper were made, stripping each time with the above solution. Each deposition was practically perfect, being smooth, highly adherent and of excellent color. The electrode showed no deterioration, and after the tenth stripping was of high metallic luster, entirely free from oxide and showed no tendency toward brittleness. Loss in weight per stripping amounted to one part in 150,000. Time for each stripping was less than 5 minutes. MEH(14)

A Magnetic Method for Determining Carbon in Steel and Its Application in Deoxidation Processes. (En Magnetisk Metod för Kolhaltsbestämning hos stal, och dess Annvandning vid Färskningsprocesserna.) C. J. GUNNAR MALMBERG. *Jernkontorets Annaler*, Vol. 114, Oct. 1930, pages 508–545; *Elektrotechnische Zeitschrift*, Vol. 52, Jan. 15, 1931, page 80.

The method depends on submitting a test piece to a variable magnetic field, and measuring the induction. Thus a sample submitted to field strength H_1 then to a lower field strength H_2 will after several repetitions show an induction B_1 and B_2 which differ by an amount characteristic of the C content. A ballistic galvanometer is used for measuring the induction, and the whole circuit is built into a compact apparatus known as a carbometer, on which the readings indicate the difference $B_1 - B_2$. The test pieces, fitting into the magnetic circuit, are ingots of 12.90 ± .03 mm. radius poured from the steel bath. Since the diameter of the ingot is likely to vary with the composition it is recommended that a series of ingots of known composition be poured and used as standards. The texture of the ingots on breakage has no effect on the readings, and the C is uniformly distributed through the sample. The value of the carbometer reading is independent of the troostite, but ferrite and cementite, which form under 0.20% and above 1.20% C. respectively, raise the carbometer value. The presence of Al has no influence on the reading for 0.60% C. but is lower for lower Al contents and higher for higher Al. Silica and Cr increase the readings; W and Mo lower them; while Mn and Ni behave somewhat as Al. O, H, and N produce marked irregularities. HCD + Ha(14)

Rapid Method for the Determination of Selenium. (Schnellmethode zur Bestimmung von Selen.) E. BENESCH & E. ERDHEIM. *Chemiker Zeitung*, Vol. 54, Dec. 10, 1930, page 954.

A solution containing 0.1 to 0.15 g. Se and 5 cc. conc. HCl is treated with 30 g. hydrazine hydrochloride or hydrazine sulphate and boiled. After settling for 1/2 hour Se changes from red to black modification. The precipitate is filtered through a weighed paper, carefully washed and dried. If the sample is in form of a powder, it is heated in a nickel crucible with 3 g. Fe_2O_3, 3 g. $KClO_4$ and 4 g. $NaHCO_3$ until it sinters slightly. Overheating must be avoided. The residue is washed into a beaker and the analysis continued as above. The expensive hydrazine can be recovered from the filtrates after standing and recrystallization. CEM(14)

A Method for the Separation of Lead and Bismuth. (Über ein Verfahren für die Trennung von Blei und Wismut.) H. BLUMENTHAL. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 140–142.

See *Metals & Alloys*, Vol. 1, March 1930, page 431. (14)

Determination of Lithium. M. H. BROWN & J. H. REEDY. *Industrial & Engineering Chemistry, Analytical Edition*, July 15, 1930, pages 304–306.

Sodium and potassium chlorides are insoluble in acetone, while lithium chloride is very soluble. This difference is made the basis of separation of lithium from sodium and potassium. Details of the procedure are given. MEH(14)

Potentiometric Titrations. A Review and a Report of Progress. N. HOWELL FURMAN. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, pages 213–224.

This review includes a classified bibliography of potentiometric titration methods, and applies to many metals. Author classification is also given, 227 references being included. MEH(14)

The Quantitative Analysis of Steels by Spectrum Analysis. F. TWYMAN & A. A. FITCH. *Engineering*, Vol. 130, Nov. 14, 1930, pages 635–636.

Condensed from paper read before the Iron & Steel Institute, Prague, Sept. 15, 1930. *Metals & Alloys*, Vol. 2, Jan. 1931, page 12. LFM(14)

The Analysis of Residues of Alloys Steels by Chlorination. (Lässt sich die Rückstandsanalyse durch Chloraufschluss auf legierte Stahlsorten anwenden.) R. WASMUHT. *Archiv für Eisenhüttenwesen*, Vol. 4, Sept. 1930, pages 155–159; *Stahl und Eisen*, Vol. 50, Oct. 2, 1930, pages 1407–1408.

In a previous investigation by Oberhoffer and Wasmuht (*Archiv für Eisenhüttenwesen*, Vol. 2, 1929, pages 829–842), a method was described to determine, by chlorination, oxides which are found in the residues of steels dissolved in acid. This investigation refers to the determination of chromium oxide, tungsten oxide, molybdenum oxide, nickel oxide and cobalt oxide by the same method. The method can be used only in case the carbides present are already completely disintegrated at the temperatures used in chlorination. The results are that the determination of oxygen which is combined with W, Mo, Ni and Co is not possible, since chlorine gas attacks these oxides at temperatures at which the attack of the gas on the carbides present is not yet completed. Only the determination of chromium oxide seems possible when a chlorination temperature of 500° C. is applied. In order to obtain reliable results the same time of chlorination must be used. The method was used to determine the content of chromium oxide of various ball bearing steels of English and Swedish origin which, though similar in composition, showed remarkable differences in quality. This difference could be traced back by the chlorination method to an essential difference in the amount of chromium oxides present. For an abstract of the earlier article see *Metals & Alloys*, Vol. 1, Sept. 1929, page 120. GN(14)

Determination of Metallic Iron in Ores. (Über die Bestimmung des metallischen Eisens in Erzen.) W. ACKERMANN. *Chemiker Zeitung*, Vol. 55, Jan. 14, 1931, pages 30–31.

Contains 4 references. The method investigated depends on the reaction $Fe + HgCl_2 = Hg + FeCl_2$, by which metallic iron can be separated from some of its compounds. After filtering and adding Reinhardt solution, Fe is titrated with $KMnO_4$. This method gives good results when Fe is mixed with oxides, but gives low results if mixed with limonite and high results if mixed with FeS, ferro-phosphorus or Fe_3C. CEM(14)

Short Method for Complete Analysis of Magnesium-Aluminum Alloys. S. S. SINGER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, July 15, 1930, page 288.

The analysis of aluminum alloys containing magnesium presents difficulties owing to the fact that Fe and Al, which form phosphates insoluble in ammonia, must be removed before the Mg can be determined. The proposed shorter but still accurate scheme is based upon the fact that Fe and Al will not be precipitated by sodium ammonium phosphate in the presence of tartaric acid, while the Mg will be precipitated quantitatively. Chilling is resorted to in order to speed up the precipitation. Details of the method are given. MEH(14)

HISTORICAL & BIOGRAPHICAL (15)

Aluminum Alloy Progress. *Iron Age*, Vol. 126, Nov. 20, 1930, page 1455.

Investigation of Al alloys was first started by Deville about 1855. Al-Si alloys were investigated at a very early date but little use resulted until later. Al-Mg alloys were used on a small scale between 1890 and 1900. Beginning of present strong alloy industry and heat treatment took place about 1907–1911. From 1919 to present time intensive alloy developments have been conducted by the Aluminum Co. of America. Cites several very recent developments. VSP(15)

ECONOMIC (16)

The Extension of Canadian Platinum Extraction. (Der Ausbau der kanadischen Platingewinnung.) *Deutsche Goldschmiede-Zeitung*, Vol. 33, Dec. 13, 1930, page 590

Discussion of the large quantity of Pt now being obtained in Canada and its effect on price. JLG(16)

Union Miniere—Largest of the Copper Producers. *Engineering & Mining Journal*, Vol. 130, Nov. 24, 1930, page 506.

An abridged translation of the Company's booklet "Le Katanga Pays du Cuivre" shows the Union Miniere to be the world's greatest Cu mine. The operations are outlined. WHB(16)

The Tin, Radium and Cobalt Interests of the Union Miniere du Haut Katanga. *Metal Industry*, London, Vol. 37, Sept. 26, 1930, pages 289–291.

Translation of portions of a brochure in French by the Union Miniere de Haut Katanga dealing with the tin, radium and cobalt mines of the company. VSP(16)

Sees Potential Steel Market of Over 161,000,000 Tons. *Iron Trade Review*, Vol. 86, June 26, 1930, pages 43–45.

Trade Research Division of the National Association of Flat Rolled Steel Manufacturers estimates a total annual possible consumption of about 8,180,000 tons in the fields covering office furniture, household furniture and equipment, automobile wheels and bodies, pressed and welded steel parts shelving and bins, steel lath, steel buildings, building materials, electric light and telephone poles, and farm markets. Total possible consumption is estimated to be 161,113,340 tons. MS(16)

Magnesium and Its Compounds in 1929. PAUL M. TYLER. *Mineral Resources of the United States*, 1929, Part II, pages 119–138, *United States Bureau of Mines*, Nov. 20, 1930.

In 1929, domestic output of metallic Mg was 665 short tons, an increase over 1928 of 155%. The entire output comes from the Dow Chemical Co., who make it from magnesium chloride. Much progress has been made in the development of extrusion, forging and other fabrication methods. Mg wire and ribbon are used largely for degassification of radio tubes. Extruded ribbon is used in various heating appliances; it is wound around the article to be insulated and then subjected to superheated steam which converts the metallic ribbon into an insulating film of oxide. AHE(16)

The Iron Industry of China. (Chinas Eisenindustrie.) KARL WENDT. *Stahl und Eisen*, Vol. 51, Jan. 1, 1931, pages 1–8.

The article deals with the historical development of the Chinese iron industry, surveys the deposits of ores and coal and describes all Chinese iron and steel manufacturing companies. The raw materials for a large scale steel production are available, the transportation system must be improved, however, before a successful iron industry can be built up. GN(16)

Research and Promotion Will Aid Castings Industry. ROGER L. WENSLEY (G. M. Basford Co.). *Steel*, Vol. 87, July 10, 1930, pages 50–51, 60.

From a paper read before Steel Founders' Society of America. MS(16)

The Economic Position of the Siegerland Iron Mining Industry Compared with the Iron Mining Industry Abroad. (Die Wirtschaftlichkeit des Siegerländer Eisenerzbergbaues im Vergleich zum ausländischen Eisenerzbergbau.) R. SCHNEIDER. *Stahl und Eisen*, Vol. 50, Feb. 20, 1930, pages 229–233.

The stagnation of the iron ore mining industry in the Siegerland is attributed to the burdens imposed on the industry by ideas of social welfare. GN(16)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

501 **Smithsteel Coat of Mail** is a modern armoring, needed where traffic and load conditions create extreme demands for resistance to wear and shock. Imbedded in the flooring material, with rings of steel exposed flush with the floor surface, it also functions as a reinforcement throughout the entire upper strata of the material. A leaflet describing it can be obtained from the A. O. Smith Corporation, Milwaukee, Wisconsin.

502 **Anodes.**—Udylite cadmium anodes have been drastically reduced in price although the quality is as high as ever. The Udylite process gives supreme rust protection and a beautiful silver-like finish. A broadside announcing the price reduction has been sent out by the Udylite Process Company, 30 East 42nd St., New York, N. Y.

503 **Automatic Control Instruments.**—Catalog No. 8008 of the Brown Instrument Co., Wayne and Roberts Aves., Philadelphia, Pa., lists their various recording, signaling, indicating, and alarm controllers for temperature, pressure, flow, etc. The catalog is fully illustrated and each instrument is discussed in a short paragraph.

504 **Copper and Brass in Construction.**—The April 15th issue of the Bulletin of the Copper & Brass Research Association, 25 Broadway, New York, N. Y., is devoted to the use of copper and brass in the construction of new buildings on the pacific coast. It also contains a short article describing an ingenious method for making patterns for bronze pieces from living flowers.

505 **Heat Treating.**—The Vincent Steel Process Co., 2434 Bellevue Ave., Detroit, Mich., has sent out a leaflet telling about their heat treating process and the advantage of having steel heat treated at a plant where it is under the personal supervision of competent workmen.

506 **Calcium Molybdate.**—An interesting book with this title is published by the Climax Molybdenum Co., 295 Madison Ave., New York, N. Y. It discusses this salt very thoroughly, giving its use in alloying iron and steel with molybdenum and the amounts necessary in the various steel-making processes. A brief discussion of molybdic oxide is appended.

507 **Heat Treating Furnaces.**—Catalog 309 sent out by the W. S. Rockwell Co., 50 Church St., New York, N. Y., describes their continuous heat-treating furnaces of the pusher type. These can be obtained either electric or fuel-fired. It includes several pages of designs developed to meet different requirements for heating, cooling and handling. Catalog 294 is a reprint of a paper "Economics of Industrial Heating" which was presented at the New England Industrial Electric Heating Conference in 1929.

508 **Foundry Equipment.**—The March and April issues of "Better Methods" which is published monthly by the Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Ill., contain articles describing installations of their sandslingers in factories. In the April issue there is also an interesting article entitled "Merchandising Foundry Products."

509 **Metal Spraying Process.**—This booklet by the Metal Spray Engineering Co., 3501 Croton Ave., Cleveland, Ohio, explains their method of spraying metals, gives a list of metals that can be successfully treated this way and suggests a number of objects which can be advantageously lined or coated by spraying.

510 **Arc Welding.**—An interesting booklet on this subject has been prepared by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. It contains an article on a few applications of Automatic Arc Welding which is quite complete, illustrating the equipment and giving costs. This is quite complete, illustrating the equipment and giving costs. This is their bulletin No. 14.

511 **Alloy Steel Castings.**—The Lebanon Steel Foundry, Lebanon, Pa, has sent out a leaflet showing the use of their stainless steel castings on the "Enterprise." Modern equipment and exacting laboratory research assure the high quality, fine finish and soundness of these castings.

512 **The Laboratory.**—A new metallographic polisher is described in the Vol. 4, No. 2 issue of this publication of the Fisher Scientific Company, 711 Forbes St., Pittsburgh, Pa. There is also an article discussing the latest developments in fractional distillation and apparatus designed by Dr. K. C. D. Hickman of the Research Laboratories of the Eastman Kodak Company.

513 **Drawing-Oven.**—Leaflet GEA-785B of the General Electric Company, Schenectady, N. Y., describes their type AD Air Drawing-Oven for drawing carbon steel at temperatures up to 750°. A table showing the sizes of the different capacity ovens is given and several charts illustrating radiation losses and time and power required for various loads. Another leaflet of theirs describes their various heating devices such as soldering irons, immersion heaters, glue pots, etc.

514 **Furnace Regulators.**—Bulletin No. 840 of the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., is devoted to their automatic temperature control for blast furnaces. By using these regulators the blast pressure is smoother, the tonnage of the furnace is raised, there is less loss of flue dust and the furnace operates more efficiently. In addition to these advantages there is a remarkable saving in labor. The bulletin is fully illustrated.

515 **Electrically Heated Industrial Equipment.**—Electrically heated platens are discussed in leaflet TB-24 of the Harold E. Trent Co., 439 N. 12th St., Philadelphia, Pa. It also includes a list of other Trent products.

516 **Nickel Cast Iron News.**—The first installment of "Nickel and Nickel-Chromium Cast Iron" by Paul D. Merica appears in the April 1931 issue of this publication of the International Nickel Co., 67 Wall St., New York, N. Y. It also includes number six of the Intimate Chats on Metallography.

517 **Fahralloy.**—This is a heat, corrosion and abrasion resistant alloy which, in certain of its series, is made to completely resist the destructive effects of solutions of nitric and acetic acids and silver nitrate. This alloy was used for pipe in the Daily News Building in New York as described in a folder sent out by the Southern Manganese Division of the American Manganese Steel Co., 6600 Ridge Ave., St. Louis, Mo.

518 **Furnaces.**—One of the most modern heat treating and forging departments in the country is the newly erected division of the Spicer Manufacturing Company. The furnaces used were supplied by the Surface Combustion Company and are described in a folder sent out by them recently. 2375 Dorr St., Toledo, Ohio. They have also issued a bulletin on the installation of their gas-fired oven furnaces at the Delaware Tool Company.

519 **Rust Proofing.**—The April issue of the Udylite News, published by the Udylite Process Co., 30 East 42nd St., New York, N. Y., deals specifically with the various applications of Udylite plating in the aircraft industry, although some household articles are illustrated which are Udylite plated.

520 **Electric Borium.**—The April issue of Fusion Facts by Stoody Co., Whittier, Calif., is given over to a discussion of their Electric Borium. There is some consideration of the cost of applying it and instructions for its use. There are profuse illustrations of several building-up processes using this product.

521 **Metal Melting Furnaces.**—The Campbell-Hausfeld Co., Harrison, Ohio, manufacture all types and sizes of these furnaces from a small one for laboratory use to a barrel type furnace with a capacity of 2000 lbs. The various kinds are illustrated and priced in their catalog 27. Some of their other items such as skimmers, nozzles, strainers, etc., are shown also.

522 **Welding.**—An interesting article on the welding of various alloys is a feature of the April issue of Oxy-Acetylene Tips which is published by the Linde Air Products Co., 30 E. 42nd St., New York, N. Y. Several articles on the repair of apparatus by welding are also of interest. The magazine is fully illustrated.

523 **Flue Gas Temperatures.**—Information furnished by an accurate and reliable pyrometer equipment for measuring flue gas temperatures enables a boiler plant operator to keep the loss of heat in waste gases at a minimum for his particular plant. Bulletin No. 872 issued by the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., illustrates a number of their pyrometers for flue gas with a complete description of each type and its price.

524 **Furnaces.**—Bulletin No. 190 put out by H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa., describes their straight line continuous electric furnaces for heat treating strip metal and wire. Bulletin No. 160 is entitled "Electrically heated Large Asphaltum Coating Tanks" and Bulletin No. 170 is "Electrically Heated Compound Melting Tanks."

525 **Non-Ferrous Castings.**—The Development and Research Department of the International Nickel Co., 67 Wall St., New York, N. Y., has recently issued a booklet entitled "The Use of Nickel in Non-Ferrous Castings." In this report the effect of nickel on the properties of brass and bronze is noted. Several useful tables are given showing typical compositions of nickel for various purposes. A list of special alloy compositions containing nickel, with their trade names is convenient for reference.

526 **Belts.**—Four points of superiority are claimed for belts manufactured by the E. F. Houghton & Co., Philadelphia, Pa., in a leaflet recently issued by them. This belt has a tensile strength of 5000 lbs. per square inch, is adaptable to the smoothest surface, regains its shape after being distorted and can be bent double in a vise.

527 **Small Generator Units.**—Small Generator Units and Their Applications, a new 12-page publication identified as Circular 1908, is announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. In it are described four different types of generators used where a small amount of electrical energy is necessary, but where no central station supply is available. These generators are discussed first from an apparatus and then from an application standpoint. Fifteen kilowatts is chosen as the limit of the small generator class.

528 **Lead.**—Extensive use has been made of lead for ornamental purposes as described in the May issue of "Lead" which is published by the Lead Industries Association, Graybar Bldg., New York, N. Y. A number of interesting industrial applications are also discussed.

529 **Pyrometer Tubes.**—X-Ray inspection of metal pyrometer tubes insures uniformity of wall thickness and soundness of metal. Every tube manufactured by the Claud S. Gordon Co., 708 W. Madison St., Chicago, Ill., is so inspected before it goes to the stock room. The prices of various sizes of these tubes are given on page 2B of Bulletin 431 which can be obtained as a reprint from the company.

530 **Brackelsberg Rotating Furnace.**—An attractive folder prepared by the Whiting Corporation, Harvey (Chicago Suburb), Ill., describes this new rotating furnace for melting malleable iron, high grade gray iron and special melting problems. It is fired with pulverized coal and is made in $2^1/_2$, 5 or 10 ton sizes, and produces high quality iron of definite analysis.

531 **Nickel Cast Iron.**—Ni-Resist is a special type of alloyed cast iron which is serving many useful purposes in the chemical and allied industries. It has great resistance to many acid and alkaline solutions, it can withstand high temperatures and has unique electrical characteristics. These features are described in detail in Bulletin No. 208 of the International Nickel Company, Inc., 67 Wall St., New York, N. Y.

532 **Dowmetal.**—This is the trade name that identifies the magnesium alloys developed and manufactured by the Dow Chemical Co., Midland, Mich. A small card has been prepared by the company which lists the composition of the different types of these alloys and suggests uses for them. On the reverse side of the card is a table comparing them with other wrought and cast alloys.

533 **Thermo-lectric Babbitt.**—The Thermo-lectric process of making babbitt is a method of graduated temperature control and hydrogenation which combines the various metals into a perfect alloy which has strength, toughness and anti-frictional qualities. A folder discussing this process can be obtained from David H. Smith & Sons, Inc., Foot of 51st St., Brooklyn, N. Y.

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Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS OF METALS & ALLOYS

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These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

Book Reviews are included below and marked by -B-

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PATENT SERVICE

Until we resume regular publication in September, the service rendered by the Patent Department of METALS & ALLOYS will be carried on by Mr. W. M. Corse, 810 Eighteenth Street, Washington, D. C. who can supply copies of United States and foreign patents and translations at reasonable costs.

GENERAL (0)

Progress in Metals. L. W. SPRING. *Metal Progress*, Vol. 1, Sept. 1930, pages 40–45.

A brief review of the advances made in the production of metals suited to the modern requirements of high pressure steam generation, petroleum refining, and the chemical industry. The value of "creep" tests is discussed. Need of a material having high strength at 1000° F. and above is expressed. The increasing applications of alloy steels, both of the pearlitic and austenitic types are noted. WHK(0)

Some Important Advances in Composition and Treatment of Metallic Alloys. (Quelques progres importants dan les proprietes et les traitements de alliages metalliques.) LEON GUILLET. *Revue de Metallurgie*, Vol. 27, Sept. 1930, pages 449–466.

A survey of the important advances in metallurgy during the last 5 years. High points are given about silicon structural steels, steels for use at elevated temperatures and high speed steels containing 5% Co. The performance of track equipment up to the present, made of Hadfield steel can be considerably improved by the use of heat treated cast steel containing about 0.30 C, 2.8–4.0% Ni and 0.8–1.5% Cr. It has better machinability, physical properties and better wear. Considerable improvement of the properties of cast iron can be made by alloying it with Ni, Cr and Mo. A description of a series of experiments by Guillet on the influence of Ni and Cr addition and heat treatment on cast iron is given. Si raises the temperature of transformation and diminishes the tendency toward martensitic hardening. Mn (0.20–0.65%) appears to have pronounced influence on hardness after secondary quenching. Ni lowers the transformation temperature below 350°, has a very favorable action on secondary quenching by reducing primary quenching. Cr added to Ni cast iron diminishes the critical speed of quenching and has a strong influence on secondary hardening. Aluminum brasses (76 Cu, 22 Zn, 2 Al) are used for condenser tubing. Ni brasses are considerably improved by this element in physical properties and resistance to corrosion proportionally to the addition of Ni. Ni-Mn brasses can be cast as easily as usual bronzes but have about double their strength and elongation and for many corrosion purposes are among the best known materials. Among aluminum alloys is mentioned a new Rolls-Royce metal (12 Zn, 3 Cu, 6 Mn, 5 Si, 4 Fe) which after quenching and aging gives 42–50 kgs./mm.^{2} tensile, 25 kgs./mm.^{2} elastic limit and 10–15% elongation. Mechanism of hardening is reviewed. It is illustrated by the results of Masing, who after quenching and aging of 5% Be-Cu alloy was able to produce hardness of 412 Brinell. JDG(0)

The Future of the American Iron & Steel Industry. ZAY JEFFRIES. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 331, 1930; *Heat Treating & Forging*, Vol. 16, July 1930, pages 872–875; *Iron Trade Review*, Vol. 86, Apr. 1930, pages 75–77, 85.

Henry Marion Howe memorial lecture before the American Institute of Mining & Metallurgical Engineers, Feb. 17–20, 1930. MS+JLG(0)

How Can the Different Kinds of Iron and Steel Be Distinguished? (Wie kann man die verschiedenen Eisen- und Stahlsorten erkennen?) H. STOEPEL. *Zeitschrift Feinmechanik und Praezision*, Vol. 35, Nov. 30, 1930, pages 1–2.

A description of methods used to distinguish different materials by simple shop tests: sound test, filing test, cutting test, fracture test, hardness test, grinding test. For the latter, the character of the sparks are described in detail. Ha(0)

Important Developments in the Gray Iron Industry. ARTHUR J. TUSCANY. *Enamelist*, Vol. 7, Aug. 1930, pages 34–36–38.

Brief reference to a few developments in the field. Enumeration of the activities of the Gray Iron Institute, to coördinate the requirements of the user of gray iron castings with the accomplishments of the producer. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. W(0)

PROPERTIES OF METALS (1)

Rare Metal Has Many Unique Properties. C. W. BALKE. *Machine Design*, Vol. 2, Dec. 1930, pages 39–42.

Characteristics of tantalum, and design possibilities. Among typical applications discussed are: spinnerets in the rayon industry; hydrochloric acid condensers; chlorine gas cylinders; electrolytic valve elements; filters and screens, etc. Tables of corrosion data and of technical characteristics are given. MFB(1)

Cold Working Properties of Tantalum. M. M. AUSTIN. *Rolling Mill Journal*, Vol. 4, June 1930, page 290.

Abstract of a paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 563. MS(1)

Tungsten and Its Alloys. (Le Tungsténe et ses alliages.) R. CAZAUD. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Oct. 1930, pages 423–427.

Physical properties, preparation and uses of tungsten metal, also the Fe-W diagram are given. Steels containing tungsten have a higher elastic limit at higher temperatures than Ni or Ni-Cr-Mo steels. Steels resistant to oxidation are made with 26% Ni, 14% Cr, and 3% W. GTM(1)

Manganese and Its Alloys. R. CAZAUD. *Metals & Alloys*, Vol. 1, Aug. 1930, pages 678–680

A translation. See abstract of original, *Metals & Alloys*, Vol. 1, Dec. 1930, page 897. ESC(1)

The Thermal Conductivities of Copper and Nickel and Some Alloys of Nickel. W. C. ELLIS, F. I. MORGAN & G. F. SAGER. *Rensselaer Polytechnic Institute Bulletin*, No. 21, Sept. 1928, 23 pages.

Determinations of the thermal conductivity of 2 grades of nickel and of some nickel alloys gave the following values, which are in good agreement with determinations made by earlier investigators, using different methods:

	Cal./cm./sec./° C.
Nickel (1)	0.147
Nickel (2)	0.168
"Climax" (Ni 30, Fe 70%)	0.0329
"Climax 193" (Ni 28, Fe 68, Cr 2, Mn 1%)	0.0329
"Nichrome" (Ni 80, Cr 20%)	0.0358
"Nichrome" (Nickel 62, Chromium 12, Iron 26%)	0.0325
"Advance" (Ni 45, Cu 55%)	0.0325
"Monel Metal" (Ni 70, Cu 28, Fe 2%)	0.0832 (1)

Melting Point of Pure Tellurium. A. SIMEK & B. STEHLIK. *Collection of Czechoslovak Chemical Communications*, II, No. 5–6, May-June 1930, pages 304–314. 18 references.

Pure metal was obtained by redistilling the precipitated tellurium in vacuum. The method used for determining the melting point of tellurium was essentially that developed in the Geophysical Laboratory of the Carnegie Institution of Washington. This method consists in heating a small charge of the substance in a carefully regulated electric resistance furnace of considerable heat capacity, the temperature of which rises steadily and uniformly per unit of time, say, 2.3 or 4° F. per minute, and is measured separately and alternately with that of the charge every minute or half-minute by means of thermoelements of purest Heraeus platinum and a 10% rhodium-platinum alloy (wires 0.4 mm. thick) which must be carefully homogenized and calibrated before (and when necessary also after) use. Pure tellurium melts in vacuum at 452° C. This melting point is lowered in H and in CO_2 by about 0.15 and 0.2° C., respectively, per 1 atmosphere pressure which can be explained by assuming that both gases dissolve to a considerable extent in fused tellurium at its melting point, the volume absorbed being roughly of the same order of magnitude as the volume of the liquid metal itself. This work was carried on at the physico-chemical Institute of Masarik University, Brno. GTM(1)

PROPERTIES OF FERROUS ALLOYS (3)

High-Test Cupola Malleable Iron Melted with Hematite. (Hochwertiger, mit Hämatit erschmolzener Kupolofen Temperguss.) O. BRAUER. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 51, Jan. 26, 1930, pages 70–72.

Exception is taken to the article by Stotz, in the Jan. 19 issue of this journal, in which he states that hematite has an injurious effect on malleable Fe. The reply of Stotz is appended. (3)

Technological and Metallurgical Fundamentals of High-Test Cast Iron. (Die giessereitechnischen und metallurgischen Grundlagen des hochwertigen Gusseisens.) A. ACHENBACH. *Giesserei*, Vol. 17, Mar. 14, 1930, pages 245–251.

Properties of cast Fe which deviate from those of steel are attributed to the nature of the gray Fe structure. It is, therefore, concluded that means of improving mechanical properties by grain refinement and the prevention of internal defects in casting are necessary. (3)

Gray Iron Possesses Valuable Engineering Properties. *Foundry*, Vol. 58, May 1, 1930, pages 209–212.

Some permanent deformation results on application of even slight stresses to gray cast Fe. In case of steel a quite different condition is met. Gives results of tests conducted on Fe containing 3.25% C, 1.90% Si, 0.25% P, 0.60% Mn and 0.075% S. Results showed total permanent deformation as measured by a dividing engine and by extensometer in 2 in. gage lengths after 25 stress applications:

Series	Dividing Engine Inches	Extensometer Inches
1	0.0020	0.0021
2	0.0028	0.0023
3	0.0028	0.0029
Steel	0.0005	0.0005

Cold working was limited and incipient fracture exists. Results obtained are as follows:

Series	Break Restressed Bar	Break Check Bar	% Difference
1	36,250	34,550	4.69
2	36,010	38,000	5.23
3	21,750	22,500	3.34

Test conducted on untreated bar decreased the stress 55% of ultimate strength. Exact maximum loads above which continued applications of stress would result in failures are determined by creep or flow tests. When slight initial permanent deformation at intermediate loads is objectionable, cast Fe members should be designed heavy. VSP(3)

Properties of High Strength Structural Steels. *Iron Age*, Vol. 126, July 3, 1930, pages 16–18.

From a discussion at the Atlantic City meeting of the American Society for Testing Materials. The conferences centered upon applications of present-day importance of aircraft, bridges, ships, pipe lines and heat corrosion resistant equipment. Attempt was made to draft schedules of wall thicknesses for all sizes of wrought pipe to suit different operating conditions. For high strength structural and ship steel ultimate strength will be raised from 60,000 to 72,000 lbs./in.^{2} A well deoxidized steel of at least 0.20% C and 0.60% Mn can be improved in tensile properties by heat treatment. A 0.30% C and 1.25% Mn steel if normalized possesses a 45,000 lbs. proportional limit. Data on cold drawn bridge wire was presented by Leon S. Moisseiff. The steel was acid open-hearth having a 0.85% C limit. Required physical properties of galvanized wire were: Tensile strength: More than 215,000 lbs./in.^{2} Yield point: more than 144,000 lbs./in.^{2} Elongation in 10 in.: more than 4%. The relative merits of some alloy steels was discussed by Bradley Stoughton and W. E. Harvey. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 843. VSP(3)

Factors in Quality and Strength of Forgings. L. M. JORDAN. *Heat Treating & Forging*, Vol. 16, March 1930, pages 328–330.

Locomotive forgings must be made from steel manufactured by correct methods and cast in properly designed molds. Proper solidification must be allowed for when the ingots are cast, and correct reheating and working into billets must be practiced. Addition of V improves the properties of steel. A low C 2% Ni steel with moderately high Mn content has lately come into prominence. All these steels must be heat treated. Reviews investigations carried out on fatigue phenomena. True cause of fatigue has not yet been definitely established. MS(3)

The New Manganese Alloy Steels. E. E. THUM. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 215–240, includes discussion; *Engineering*, Vol. 130, Aug. 29, 1930, page 281.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 842. LFM(3)

Recent American Researches on the Physical Properties in Cast Iron. P. BARDENHEUER. *Foundry Trade Journal*, Vol. 43, July 17, 1930, page 38.

Abstract of paper read before the German Foundry Technical Association. Suggestions are made for the classification of cast Fe into 40 classes, according to the C and Si contents. Special considerations to be given to raw materials, cooling speed and shape and size of castings. VSP(3)

Production and Properties of Chill Rolls. (Hartgusswalzen, ihre Erzeugung und Eigenschaften.) W. BREITENBACH. *Giesserei-Zeitung*, Vol. 27, Dec. 15, 1930, pages 655–660.

The melting and casting practice of chill rolls used by various industries (the rubber, paper, ceramic and leather industries) is considered in detail. The cause and remedies of failures are outlined. GN(3)

Growth of Cast Iron. (Wachsen des Eisens.) W. SCHRECK. *Giesserei-Zeitung*, Vol. 27, Jan. 1, 1930, pages 1–3.

Investigations up to the present have shown that growth is greatly increased after passing the critical temperature zone of 750° C. with ordinary Fe. Not only does growth occur but expansion of Fe begins at considerably lower temperatures and with heating at 400°, cast Fe, when quenched, does not return to its original state. (3)

Beryllium-Iron Alloys. (Die Legierungen des Berylliums mit Eisen.) G. KROLL. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 8, Mar. 9, 1929, pages 220–235; *Aciers Speciaux*, Vol. 4, Sept. 1929, pages 417–422.

Alloys discussed are: Fe-Ni-Be with 5, 15 and 36% Ni and 1% Be; Fe-Ni-Cr-Be with 5, 7, 9 and 8% Ni, 12, 20, 20 and 20% Cr and 1% Be. Tabulated data on their mechanical properties and corrosion resistance. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 383. (3)

Supermal, a Wear-Resisting Metal. *Canadian Mining Journal*, Vol. 52, Jan. 23, 1931, page 106.

The Jeffery Mfg. Co. has marketed a new line of Supermal chains and buckets. Claims for this new metal are: greater resistance to wear, higher tensile strength, and a higher elastic limit than is usual in malleable iron. The qualities compare favorably with like qualities of manganese steel chains, at a cost little more than ordinary malleable chains. WHB(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

The Influence of Stress Range and Cycle Frequency on Corrosion. D. J. MCADAM, JR. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 411–447.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 901.(4)

Bases of Corrosion. (Grundlagen der Korrosion.) G. MASING. *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 321–327. Discussion.

Paper read at the Meeting of the Deutsche Gesellschaft für Metallkunde, March 1930, Berlin, takes the following steps after giving the definition of corrosion: attack by gases and liquids, electrochemical reactions, operating scheme of an electrochemical element, source of electrochemical corrosion, general outline of corrosion attack, prevention by protecting coatings, corrosion of alloys with reference to solid solutions, intermetallic compounds and impurities. EF(4)

Theory of the Protection Effect of the "Schadebinde" against Rusting. (Zur Theorie der Rostschutzwirkung der "Schadebinde.") W. BECK. *Korrosion und Metallschutz*, Vol. 6, October 1930, pages 229–230.

Interpretation from a colloid-chemical standpoint. The remarkable protection against rusting in spite of the completely insufficient insulation is considered and the adaptability of measuring the transition resistance on moist tubes wrapped with a "Schadebinde" in order to determine the corrosion protection is discussed. EF(4)

Corrosion and Protection in Boiler Plants. (Korrosion und Metallschutz im Dampfkesselbetrieb.) R. STUMPER. *Korrosion und Metallschutz*, Vol. 6, Oct. 1930, pages 223–228.

Investigation of a brass condenser tube which failed in service. Internal stresses due to cold working are thought to be the cause which was proven by micro-examination and physical testing in the "as delivered" and annealed state. Defects or corrosion in addition to internal stresses led to failure. See translation in *Metals & Alloys*, Vol. 1, Dec. 1930, pages 895–896. EF(4)

Combating Corrosion of Aircraft Metal Parts. J. E. SULLIVAN. *Aviation*, Vol. 28, Feb. 1, 1930, pages 201–204.

A detailed discussion of preparing metal surfaces, proper coating, inspection and maintenance to insure adequate protection against possible structural failure due to corrosion. A variety of aircraft finishes are discussed. A process for protecting duralumin has been developed by pioneer aircraft manufacturers in coöperation with the Navy Department and the Aluminum Corp. of America. Suggestions are offered for the reduction to a minimum of the evils of corrosion. (4)

Report of American Society for Testing Materials Committee A-10 on Iron-Chromium, Iron Chromium Nickel and Related Alloys. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 255–258.

Includes 20 large plates constituting a revision of the data of the 1924 American Society for Testing Materials Symposium on corrosion resistant, heat resistant and electrical resistant alloys. In these tables the trade names, chemical compositions, physical and mechanical properties at room temperature and when available at elevated temperatures, and corrosion resistant properties of many commercial alloys are given. Steels containing Cr or Cr and Ni and other alloys of that class made by the Allegheny Steel Co., Bethlehem Steel Co., Carpenter Steel Co., Republic Steel Corporation, Colonial Steel Co., Crucible Steel Co., Cyclops Steel Co., Duriron Co., Firth-Sterling Steel Co., Latrobe Electric Steel Co., Ludlum Steel Co., Midvale Co., Rustless Iron Corp., Universal Steel Co., Vanadium Alloy Steel Co., Babcock and Wilcox Tube Co., Calorizing Co., Duraloy Co., Electro Alloys Co., General Alloys Co., Michiana Products Co., Michigan Steel Casting Co., Ohio Steel Foundry Co., W. T. Sweet Foundry Co., are included. Electrical resistance alloys, special alloys and aluminum, and other non-ferrous copper alloys as well as some ferrous alloys made by Driver Harris Co., Haynes Stellite Co. Burgess Parr Co., Curtis Bay Copper & Iron Works, International Nickel Co., Westinghouse Elec. & Mfg. Co., Aluminum Co. of America, American Brass Co., American Manganese Bronze Co., American Metal Products Co., Barber Asphalt Co., Chase Brass & Copper Co., Frontier Bronze Co., Riverside Metal Co., Scovill Mfg. Co., National Lead Co., Fansteel Products Co., American Rolling Mill Co., Manganese Steel Forge Co., and Meehanite Metal Corporation are given. This valuable compilation can be purchased separately from the bound volume of the Proceedings. HWG(4)

Methods of Corrosion Testing. (Verfahren der Korrosionsprüfung.) E. K. O. SCHMIDT (Deutsche Versuchsanstalt für Luftfahrt). *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 328–333; discussion pages 334–336.

Corrosion testing facilities such as immersion, alternating and spray apparatus, developed by the D. V. L. during the past years with the object of testing the corrodibility of light metal sheets are described and the evaluation of the data obtained is outlined. The results of these methods are reproducible and in fair agreement with practical experience under service conditions. Based on a wealth of experiments, the author urges the determination of ultimate strength (Bruchspannung) and elongation as the best criterion of corrosion attack, since this test yields absolute figures. The deep drawing and alternating bending test also demonstrate the progress of the corrosion attack. However, these testing methods do not permit drawing conclusions in regard to losses in strength and elongation. EF(4)

Can Ferrous Metals Resist Heat and Corrosion Successfully? H. J. FRENCH. *Iron Trade Review*, Vol. 86, Feb. 27, 1930, pages 59–61.

From a paper presented before the American Electrochemical Society, Oct. 1926. MS(4)

American Gas Association, Bureau of Standards Field Study of Long Gas Lines. S. EWING. *American Gas Association Monthly*, Vol. 13, Feb. 1931, pages 70–76.

A gas line from Amarillo, Texas to Denver, Colorado was laid 2 years ago after a careful soil survey to locate corrosive soils. The pipe was coated with a heavy coat of bitumastic "enamel," a light one of "cold paint," or left bare, according to the apparent corrosiveness of the soils. Examination of the pipe after 2 years indicates that the original estimate as to whether the soil would be corrosive or not was 73% correct. It is thought that with the information that has become available within the last 2 years, an estimate made to-day would be 79% right. The coatings failed from distortion, and only the hard enamel has value. The 4 coatings applied are described by trade name, and 2 of these showed no protective value. The electrical resistance of these coatings had fallen to a very low value. Heavy, hard coatings retarded the corrosion of the pipe. Whether the increased life afforded by such coatings is worth the cost is not discussed, a 2 year period doubtless giving insufficient data. HWG(4)

Corrosion Problems in the Viscose Silk Industry. H. R. S. CLOTWORTHY. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 445–447.

The acid and alkaline solutions used in the manufacture of silk cause serious corrosion of plant equipment which results in a weakening of the fiber by the introduction of rust, and a wearing of the fiber on roughened surfaces. There is great need for more resistant materials at many steps in the process. MPB(4)

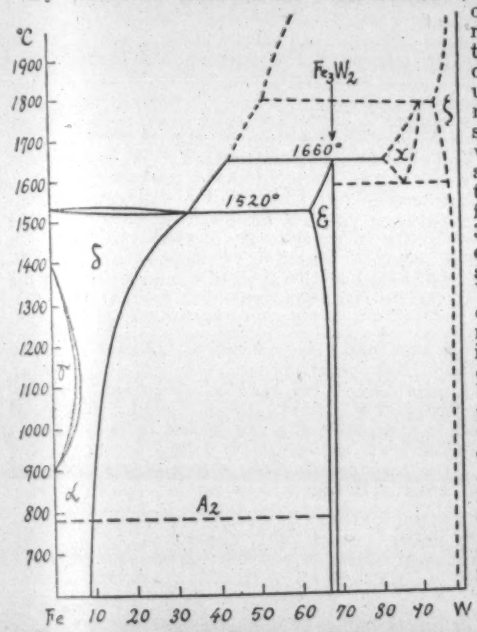
STRUCTURE OF METALS & ALLOYS (5)
Metallography & Macrography (5a)

The Transformation and the Constitution of High Chromium Steels. TAKEJIRO MURAKAMI, KOJIN OKA & SEIJI NISHIGORI. *Technology Reports of the Tohoku Imperial University*, Vol. 9, Nov. 1930, pages 405–445.

The transformation and the constitution of high Cr steels containing from 10 to 30% of Cr and less than 1.1% of C were thoroughly investigated, by the magnetic, dilatometric and microscopic methods. From the result of the magnetic analysis, isothermal curves for the A_2 point, and the composition ranges in which the lowering of the transformation takes place were determined and the following facts were deduced: (1) The A_2 point descends with increasing Cr content, when the carbon is constant, while it rises with increasing C content, when the Cr content is constant. (2) In the same alloy, the lowered transformation or the Ar″ change increases in magnitude, as the maximum heating temperature rises, or the cooling rate increases, though in high Cr steels in which no γ-phase is formed, no transformation is observable. (3) The Ar″ transformation decreases in magnitude with increasing Cr, when the C content is constant, while the transformation is more readily lowered in medium C steels than in high or low C steels, when the Cr content is constant. By the measurement of the thermal dilatation with slow rates of heating and cooling, the A_3 and A_1 points were determined and the following result was obtained: (1) When the C content is constant, the magnitude of A_3 and A_1 transformations gradually decreases until it vanishes, as the Cr content increases. The temperature of the transformation rises gradually at first and then rapidly, as the Cr content increases. (2) When the Cr content is constant, the A_1 transformation increases in magnitude and its beginning temperature on heating descends, as the C content increases. These relations were also shown with the isothermal lines for the A_1 point. By the microscopic investigation of the quenched specimens from several temperatures, several section diagrams with constant C or Cr content, and isothermal diagrams at various temperatures were constructed, from which the change of constitution with the temperatures and the composition of steels was inferred. A general diagram was also constructed from the diagrams, above referred to, and the process of crystallization for steels belonging to the several fields on the diagram was described. Lastly, the microstructures of principal steels subjected to several heat treatments were illustrated in detail. TM(5a)

On the Equilibrium Diagram of the Iron–Tungsten System. SHUZO TAKEDA. *Technology Reports of the Tohoku Imperial University*, Vol. 9, Nov. 1930, pages 447–461.

By means of dilatometric measurements, microscopic observation and other methods, the equilibrium diagram of the Fe–W system was studied and a revised diagram, as shown in the figure, was proposed. The intermetallic phase ε is a solid solution consisting of Fe_3W_2, which was confirmed by analyzing the residue separated by electrolysis or by acid, from 3 alloys containing 20, 30 and 40% of W. The eutectic point of the ε-phase and the δ-phase lies at 33% W, consisting almost wholly of the δ-phase. The peritectic reaction in which the ε-phase is formed occurs in alloys containing more than 43% W. A loop, within which the γ-phase may be formed was also confirmed by the dilatometric measurements. A probable existence of phase χ which is formed peritectically from the melt and W (or ζ-phase) is inferred from the result of the microscopic investigation, though it is not confirmed by other methods. TN(5a)



Diffusion in Cast Bismuth-Antimony-Alloys. (Diffusion in gegossenen Wismut-Antimonlegierungen.) GEORG MASING & HILDEGIRD OVERLACH. *Wissenschaftliche Veröffentlichungen aus dem Siemenskonzern*, Vol. 9, No. 2, 1930, pages 331–338.

Due to their very great relation and similarity in their lattice structure, alloys of bismuth and antimony form an uninterrupted series of solid solutions, and it has been observed that the exterior shape of cast pieces changed at homogenizing at 300° C.; the outer dimensions increase and in the interior hollow spaces are formed. This phenomenon is explained as accompanying diffusion in solid state. Ha(5a)

Studies upon the Widmanstätten Structure. II.—The Copper-Zinc Alloys and the Copper-Aluminum Alloys. ROBERT F. MEHL & O. T. MARZKE (Naval Research Laboratory). *American Institute of Mining and Metallurgical Engineers, Technical Publication* No. 392, 1931, 32 pages.

In Cu-Zn alloys the α-phase is precipitated from the β-phase as true needles. The needles are precipitated in a direction nearly [111], possibly the [556] direction. All needles of the same family, as judged by etching characteristics, have the same orientation, but it was not possible to determine the exact orientation. Upon slow cooling the γ-phase is precipitated in the form of "stars," but upon reheating quenched specimens polyhedra are formed. The lattice plane in the β-phase defined by the intersecting planes forming the stars is the (110) plane, and the plane enclosing the polyhedra is likewise the (110) plane. Precipitation of β in the precipitated γ polyhedra also formed a Widmanstätten figure. In the Cu–Al system the α-phase appears to be precipitated from the β-phase in needles, and the direction of the needles is probably the same as for the Cu–Zn system. The present work together with earlier work proves that the Widmanstätten figure may be formed of needles, plates or polyhedra, and that the lattice structure of the parent phase is not the only controlling factor. Contains 13 references. JLG(5a)

X-Ray Control in Cold Rolling Steel Sheets and Strip. REPUBLIC RESEARCH CORP. *Iron Age*, Vol. 126, Oct. 30, 1930, pages 1221–1223.

Concluding portion of an article "Physics as an Aid to Metallurgy." Attempts to illustrate the theoretical background for the present-day use of X-ray diffraction methods in the investigations of cold-rolled products. VSP(5b)

The Microscope in Metallurgy. O. W. ELLIS. *Canadian Chemistry & Metallurgy*, Vol. 15, Jan. 1931, pages 25–26, 28.

An address before the Toronto Chemical Association, Oct. 1930. The microscope aids, in the investigation of the constitution of metals and alloys; in the solution of problems of manufacture; and in the control of production. A figure shows a portion of the equilibrium diagram for the alloys of aluminum and magnesium, containing up to 20% magnesium. Applications of the microscope in aiding the manufacture and in the control of metallurgical operations are indicated. WHB(5a)

Transformation Points in Metals. (Ueber die Umwandlungspunkte von Metallen.) A. SCHULZE. *Zeitschrift für Metallkunde*, Vol. 22, June 1930, pages 194–197; Sept. 1930, pages 308–311.

As a further check upon previous work the following metals were investigated in the purest state available: Zn, Bi, Ta and Co. Experiments mainly pertain to measurements of electric conductivity, thermoelectric force and thermal expansion. No allotropy was found in case of Zn and Bi, while transformation points could be established at 225° C. in Ta and at 1128° C. in Co. Includes list of 48 references. Paper was presented before the Deutsche Gesellschaft für Metallkunde, Düsseldorf, 1929. EF(5a)

Constitution of Alloys. (Konstitution der Legierungen.) A. SCHULZE. *Giesserei-Zeitung*, Vol. 27, Feb. 15, 1930, pages 86–97.

A discussion of the physical methods of analysis, electric conductivity and its bearing on the constitution of alloys. Consideration is given to heterogeneous alloys, alloys with solid solutions and 3-dimensional diagrams. The use of electric conductivity for the study of the constitution of alloys has become an important factor in metallography. (5a)

The Relation Between the Hardness and the Particle Size of Iron-Carbide of Carbon Steels. (Die Abhängigkeit der Härte bei Kohlenstoffstählen von der Teilchengrösse des Eisenkarbids.) S. SHIMURA & H. ESSER. *Stahl und Eisen*, Vol. 50, Nov. 27, 1930, pages 1674–1675.

The particle size of iron carbide and its relation to the hardness was studied in quenching and drawing 6 different C steels (C: 0.64%, 0.82%, 0.97%, 1.16%, 1.75%; Mn: 0.08–0.16%; Si: 0.06–0.12%; P: 0.01–0.012%; S: 0.01–0.016%). All steels were heated for 1 hr. to 850° C., quenched in water and drawn then for 10 min., 30 min., 1 hr., 2 hrs., 4 hrs., 6 hrs., 10 hrs., 14 hrs., 20 hrs., 30 hrs., 48 hrs. at 700° to 720° C. All steels were drawn first for 10 min., the hardness and particle size was determined, then drawn for 20 min. more; the hardness and particle size of cementite determined again and so on until all steels have been drawn for 48 hrs. The findings are plotted in diagrams showing that the hardness decreases with increasing size of the cementite until finally, after 48 hrs. drawing, a state is reached where the hardness is practically independent of the C content. In most of the hardness-carbon content curves the eutectoid concentration is indicated by a maximum. The hardness decreases with increasing drawing time and particle size. Within a certain range of the particle size, the hardness decreases only to a limited extent and as soon as this size of the cementite is surpassed, the hardness is independent of the C content. GN(5a)

The Influence of the Transformation on the Thermal Expansion of Steels, Especially in Reference to the Change in the Expansion Coefficient. (Untersuchung des Einflusses der Umwandlung auf die Wärmeausdehnung von Stählen unter besonderer Berücksichtigung der Aenderung der Ausdehnungszahl β.) H. SIEGLERSCHMIDT. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 135–139.

Using the quartz dilatometer described by Sieglerschmidt in *Zeitschrift für Instrumentenkunde*, Vol. 45, No. 8, 1925, pages 374–378, thermal expansion curves can be obtained up to 850° C. or even 900° C., which give satisfactory figures for coefficient of expansion as well as show the critical ranges. Data are given for 4 samples as follows:

Mark	C	Si	Mn	P	S	Cu	Ni	Co	Cr	Coefficient ($\times 10^6$) at 100°	300°	500°	700°
A	.71	.36	.62	.014	.032	.18	.20	.03	.04	12.3	14.5	17.0	17.6
R	.61	.26	.53	.025	.020	.17	.08	...	.23	12.5	14.5	16.5	18.0
M	.22	.29	1.00	.022	.021	.17	.10	.04	.08	12.8	14.8	16.8	17.8
E	Electrolytic iron									12.9	14.7	16.5	16.5

HWG(5a)

An Investigation of Type-Metals. Part 5. On the Microstructure of the Lead-Antimony-Tin Alloys. NOBUTOSHI AOKI, SHOJIRO WAKI & JIRO IKEDA. *Naikaku Insatsu-kyoku Kenkyujo Chosa Hokoku (The Report of the Research Laboratory, Government Printing Bureau, Japan)*, No. 21, Nov. 1930, pages 37–45.

Fifty-five photographs of the ternary alloys of the Pb–Sb–Sn system, chiefly those of the composition range of actual type-metals such as 50–100% Pb, 0–30% Sb and 0–20% Sn, are shown, and the structual constituents of each alloy are elucidated. The equilibrium diagram of this ternary system constructed by the present authors, was ascertained by the microstructures. The primary crystals, α-, β-, γ- and δ-ternary solid solutions, are well etched by a water solution of 5% $FeCl_3$ and 45% HCl and also by an alcohlic solution of 5% HCl. Especially α- and β-crystals are more etchable by the alkaline solutions of $K_3Fe(CN)_6$. In the ternary eutectic structure the closely co-existing α-, β- and δ-solid solutions are well observable. The primarily separated α- and β-solid solutions tend to segregate at the upper part in the melt. TS(5a)

Structure & X-ray Analysis (5b)

The Problem of the Molecular or Atomic Solid Solution of a Metal Compound in a Matrix. (Zur Frage der molekularen oder atomaren festen Lösung einer Metallverbindung im Grundmetall.) G. WASSERMANN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 46–47.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 907. HWG(5b)

An X-ray Study of the Constitution of Some Copper-Nickel-Aluminum-Manganese Alloys. LYMAN J. WOOD. *Journal American Chemical Society*, Vol. 52, Oct. 1930, pages 3833–3838.

Describes methods and apparatus used, and tabulates results. Both the photomicrographs and X-ray patterns show that these alloys are in the main α-solid solutions. Some evidence for a second constituent is presented but complete identification has not yet been made. VSP(5b)

X-Ray Apparatus. L. G. H. SARSFIELD. *Electrician*, Vol. 106, Jan. 9, 1931, pages 47–8.

Recent developments in the electrical equipment and the new British tubes and instruments are noted. The self-protected hot cathode vacuum type of X-ray tube is in demand, since it dispenses with the heavy and cumbersome tube container. Two notable additions during 1930 to the Philips Metalix range are: (1) the high power medium voltage rotating anode tube in which the anode, a heavy body of copper, forms the rotor of a small induction motor whose stator is a wound ring surrounding the tube; and (2) the large water-cooled tube with a continuous rating of 240,000 volts (peak at 8 m.a.). Each type has a fine focus. (1) is applicable in the medical sphere, and (2) in metal radiography. A recent development is the double focus type tube in which 2 cathode filaments are provided. WHB(5b)

Suppressed Constitutional Changes in Alloys. G. SACHS (The Metallgesellschaft A. G.). *Preprint, American Institute of Mining & Metallurgical Engineers*, 1931, 10 pages.

A method for determining the change in solid solubility by X-ray diffraction methods is described. The determination of the solubility of Cu in Ag by this method is described. The transformations in Au-Cu alloys are discussed in light of recently reported crystal structure studies. Mathematical formulae for the kinetics of transformations in solid alloys are developed. JLG(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Fatigue Studies of Telephone Cable Sheath Alloys. J. R. TOWNSEND & C. H. GREENALL. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 395–405.
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846. (6)

The Elastic Limit in Shock Tests. (Die Streckgrenze im Schlagversuch.) N. DWIDENKOW & K. JURJEW (Russia). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 231–236. 13 references.
Tensile impact tests are cited to show that the elastic limit of various steels is about 25% higher in impact than in a static test, and the effective elongation is 4 times as great. HWG(6)

Structure Changes During Alternating Stressing. (Gefügeveränderungen beim Dauerbruch.) U. DEHLINGER. *Metallwirtschaft*, Vol. 10, Jan. 9, 1931, pages 26–28.
Contains 8 references. Alternating bend tests were made on cold rolled strips of Ag and Cu and the test pieces were examined by X-rays. The results prove that a cold rolled metal recrystallizes when subjected to alternating stress. The X-ray (Debye) lines, which had been widened, become sharper and definite grains are formed. The magnitude of these changes is a function of the amount of bending necessary to break the test pieces. CEM(6)

Fatigue Testing Machines. (Maschinen für Dauerversuche.) W. DEUTSCH. *Zeitschrift für Metallkunde*, Vol. 22, Feb. 1930, pages 56–61.
This paper, presented at the Session of the Deutscher Verband für die Materialprüfungen der Technik, Oct. 1929, Vienna, reviews the various fatigue testing machines. The different groups are outlined and representative machines or their principles are illustrated. See *Metals & Alloys*, Vol. 1, May 1930, page 524. EF(6)

Cast Iron Testing Methods. (Gusseisen—Prüfungsmethoden.) E. DÜBI (L. von Roll Eisenwerke, Switzerland). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 10–24.
The French suggestion of cutting small test pieces from a casting is not approved. Separately cast test pieces are preferred. From hollow castings made from 5 grades of cast iron and having walls of different thicknesses, specimens were cut and tested. The properties of the specimens from the various locations are compared with those of separately cast specimens in curves and tables, and micrographs are given. HWG(6)

Endurance Properties of Steel in Steam. T. S. FULLER. *Rolling Mill Journal*, Vol. 4, Mar. 1930, page 98.
Abstract of a paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 565. MS(6)

Plasticity of Copper-Zinc Alloys at Elevated Temperatures. ALAN MORRIS (Bridgeport Brass Co.). *American Institute of Mining and Metallurgical Engineers, Technical Publication* No. 390, 1931, 9 pages.
The hot working properties of a series of Cu-Zn alloys was determined by dropping a 50-lb. hammer a distance of 4 ft. onto samples $^1/_2''$ in diameter and $^3/_4''$ long. The samples were heated to temperatures between 600 and 850° C., and their reduction in height determined. The alloys considered the most difficult to hot work, roughly 63 to 80% Cu, had the smallest reduction. Tough-pitch, phosphorized Cu, Muntz metal, machine steel and tool steel were also studied. A mathematical analysis of the resistance offered by the materials to deformation is given. Pb, Sn, Al and Zn were tested at room temperature. The resistance offered to the dynamic pressure by Pb, Sn and Zn is much greater than for a static pressure. For Al the difference is quite small. Contains 3 references. JLG(6)

The Methods of Mechanical Testing of Light Aluminum Alloys. S. NEKRYTY (Kiev Polytechnic Institute, Russia). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 277–292, 9 figures.
General discussion. Claims that test pieces of No. 12 Alloy cast separately give the same results as specimens cut from castings and, on the basis of endurance tests carried only to 25 or 35 millions, and plotted on Cartesian coördinates, to have established that Al alloys have true endurance limits. Claims that the best method of determining corrosion resistance of Al alloys is attack for 15 minutes in 10% HCl. Alleges a relationship between this corrosion test and the endurance properties. Unfortunately, there is no discussion of the papers in this publication, as had there been discussion, all the author's conclusions would doubtless have been challenged. HWG(6)

Tests on the Resistance of Cast Iron to Wear. (Essais de Résistance de la Fonte à l'Usure.) R. SPAZIER (State Railways, Czechoslovakia). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 64–73.
Wear tests were made on an Amsler machine, using a steel disc 4 cm. diameter, 1 cm. thick, and a cast iron specimen 3 cm. wide, 1 cm. thick machined to fit the curve of the disc, and pressed upon it with 25 kg., giving a pressure of 12,000 lbs./in.^{2} It is operated at 188 r.p.m. The wear was determined by loss of weight at 10 minute intervals. The loss at the first 10 minute period, while the specimen is "wearing in" is disregarded, and the average of at least 3 later 10 minute periods taken as the wear figure. Individual figures for the 10 minute periods vary, in one case cited, 600% (from 0.0004 to 0.0025 grams per cm.^{2}). Duplicate tests run for 1 hour instead of 10 minutes (after running in) may vary 200% and more, and show higher wear rates than when the abraded particles are cleaned off for weighing every 10 minutes. Two series of tests are given. In the first, the steel disc was 255 Brinell, 122,000 lbs./in.^{2} tensile, the second 212 Brinell, 99,500 lbs./in.^{2} tensile. The wear loss figures are in grams per cm.^{2} of contact surface per 10 minutes, and are averages of several 10 minute runs after a first 10 minute run.
The lowest wear rate occurs with both high combined carbon and high P. The specimen over 210 Brinell had a much lower wear rate than the softer ones. Wear is not related to tensile strength.

Series	% Composition of Cast Iron: Total C	Graphitic C	Combustion C	P	S	Mn	Brinell	Tensile-Bending-Shock lbs./in.^{2}			Wear Loss Grams/cm.^{2}/10 min.: On Cast Iron Specimen	On Steel Disc
A	3.25	2.66	0.59	0.58	0.09	0.48	169	26000	48500	0.31	0.15	....
	3.27	2.54	0.73	0.58	0.08	0.33	190	26000	31500	0.28	0.56	....
	3.37	2.87	0.50	0.83	0.05	0.68	204	23500	32500	0.28	0.11	....
	3.21	2.35	0.86	0.72	0.10	0.36	204	25000	45000	0.26	0.10	....
	2.93	2.13	0.80	0.71	0.09	0.37	200	31000	56000	0.24	0.93	....
	3.28	1.90	1.38	0.65	0.15	0.35	243	24000	46000	0.21	0.005	....
	3.22	1.68	1.54	0.57	0.16	0.33	241	22500	44500	0.23	0.012	....
	3.27	2.43	0.84	0.59	0.05	0.42	176	27500	50000	..	0.76	....
B	3.36	2.23	1.13	0.23	0.11	0.41	197	26000	47000	0.28	0.93	....
	3.57	2.00	1.57	0.77	0.14	0.45	211	28000	...	0.37	0.004	0.0008
	3.36	1.86	1.50	0.81	0.17	0.39	234	29000	...	0.34	0.0025	0.0005
	3.15	1.69	1.46	0.85	0.17	0.37	246	27000	...	0.33	0.0015	0.0005

HWG(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Development of Electrodeposition. R. MORDAUNT. *Metallurgia*, Vol. 1, Apr. 1930, pages 251–253.
A general discussion of the applications of electroplating. JLG(7a)

Rhodium Plating Process. *Brass World*, Vol. 27, Mar. 1931, page 61.
Rhodium plating provides a hard non-tarnishable surface with a brilliant white color resembling platinum in appearance. The materials, equipment, operation and solution maintenance are outlined. The plating oufit must be capable of producing 50 amperes at 6 volts or higher. A platinum anode and acid proof wires for suspending the work are used. Application at present is chiefly in the jewelry trade. WHB(7a)

A New Abnormality in the Properties of Aqueous Solutions of Cadmium Salts. ELMER TESCHE & PIERRE J. VAN RYSSELBERGHE. *Preprint* 59-8, *American Electrochemical Society*, April 1931 Meeting, 4 pages.
Electrolysis of aqueous solutions of cadmium iodide yields cathode deposits containing a large amount of adsorbed cadmium iodide. Cadmium bromide behaves in the same way, while cadmium chloride yields normal deposits of pure cadmium. The phenomenon is ascribed to the adsorption of neutral molecules. An explanation for the difference of behavior of the iodide and the bromide on one hand, and of the chloride on the other hand, is suggested. (7a)

Scientific Control of Electroplating Particularly of Nickel and Chrome Plating (Le controle scientifique dans l'industrie des depots electriques, et particulierement des depots de nickel et de chrome). M. BALLAY. *Revue de Metallurgie*, Vol. 27, June 1930, pages 316–325; *Chimie et Industrie*, Vol. 23, Mar. 1930 (Special issue), pages 253–263.
Factors bearing on the electrodeposition of metals are given. Methods of control of composition, pH (colorimetric standards) temperature, current density (a special apparatus for direct determination is described), relative motion of the electrodes and hardness of deposit are given. Three types of baths are known for Ni plating, cold with current density of 0.5–1.0 amp., warm at 30° C. and current density up to 5 amp., and stirring with a current of air and with current density 10–15 amps. The latter has become very popular in France. The composition of the bath is: $NiSO_4 . 7H_2O$ – 450 g.; $NiCl_2 . H_2O$ – 22 g.; H_3BO_3 – 22 g. (per liter) to which is added 1 ml. of $Ni(NO_3)_2$. It is run at pH 4.4–5.5. $Ni(NO_3)_2$ is added because with high current densities an oxidizing agent must be present to prevent the formation of H_2 bubbles. A table showing this effect when $Ni(NO_3)_2$ or $KMnO_4$ is added is given. Conditions necessary for good chromium deposition are taken from the paper by H. E. Haring and W. P. Barrows "Electrodeposition of Chromium from Chromic Acid Baths." (Technological Paper No. 346 of the Bureau of Standards.) Brittleness of the coating is determined by driving a point into the metal and observing the amount of its penetration at the moment of the appearance of the cracks or bending the article and noting the angle at which the cracks appear. Hardness cannot be satisfactorily measured with the present machines. Adherence of the coating can be tested by bending or by a method now under investigation. When a coated article is used as cathode and a few dozen amps./dc.^{2} are passed through it a properly adhering coat remains unaffected while those with deficient adherence peel off. Corrosion resistance can be determined either for the coating itself or for the protection offered by it to the underlying base. In the latter case, feroxyl method is helpful. The determinations of the thickness of coating all involve the knowledge of the area of the sample and the determination of the weight of coating after removal of it from the base. JDG(7a)

The Deposition of Nickel at a Low pH. A. KENNETH GRAHAM. *Metal Industry*, New York, Vol. 29, Mar. 1931, page 118.
Abstract of a paper by C. H. Mougley & W. M. Phillips in the Monthly Review of the American Electroplaters Society, Sept. 1930. Using at high temperatures a nickel solution composed of single nickel salts 32–40 oz., boric acid 3 oz. and nickel chloride 3 oz. and a pH of 1 to 2.5 and current densities well over 100 amps./ft.^{2} very satisfactory deposits are obtained despite an initial tendency to cause pitting. PRK(7a)

Throwing Power of Cyanide Copper Baths. L. C. PAN. *Monthly Review, American Electroplaters' Society*, Vol. 18, Feb. 1931, pages 6–12.
Description of apparatus required; effect of sodium carbonate; effect of sodium thiosulphate; effect of NaOH, effect of NaCl; formulas recommended. MFB(7a)

Calcium Chloride Testing of Electroplated Deposits. H. C. MOUGEY (General Motors Corp.). *Brass World*, Vol. 26, Nov. 1930, pages 301–303.
A paper presented at the 58th general meeting of the American Electro-Chemical Society at Detroit, Sept. 25–27, 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. WHB(7a)

The Electro-Deposition of Cobalt-Nickel Alloys. Part II. S. GLASSTONE & J. C. SPEAKMAN. *Transactions Faraday Society*, Vol. 27, Pt. 1, Jan. 1931, pages 29–35.
An investigation of the compositions of the alloys of Co and Ni deposited from well-buffered solutions of definite pH concentration, containing various mixtures of the sulphates of these metals, at a series of current densities and at temperatures of 50° and 90° C. The relative tendency of Co and Ni to deposit was found to be independent of the pH concentration of the electrolyte. The alloys deposited at very low current density contain increasing proportions of Co as the temperature is raised. The proportion is, in general, less than that in the solution for depositions made at 90° C. With increasing current density the proportion of Co in the deposit increases rapidly until a constant maximum Co content, independent of current density, is attained; this maximum decreases with increase of temperature. The influence of Co on the deposition of Ni at 50° C. and 90° C. is very similar to that of Fe at 15° C. and 50° C., respectively. OWE(7a)

Modern Nickel Plating Methods. (Les methodes modernes de nickelage.) MARCEL BALLAY. *Bulletin de la Societe Francais des Electriciens*, Vol. 10, May 1930, pages 545–571.
Description of the contemporary nickel plating practice both in Europe and America. JDG(7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

International Specifications for Gold-Covered Metals. *Brass World*, Vol. 26, Nov. 1930, pages 289–291.

A report of the "Gold-Covered Articles Commission" before the International Jewelers' Congress in May 1930. It is proposed that Au-covered articles be stamped with a mark indicating the process of manufacture. "Plaque" articles should be distinguished from gilt. French and Swiss systems of marking are discussed. The Commission recommends the addition of representatives from Spain, Sweden, Holland, and the United States of America. WHB(8)

Huge Electric Press is Used in Making Synthetic Wrought Iron. *Electric Journal*, Vol. 28, Jan. 1931, page 26.

The A. M. Byers Co. is making wrought iron mechanically. The puddle balls previously worked by hand are placed in the 900-ton motor-driven press and squeezed into 6000-lb. wrought iron ingots. The main press is driven by a 2100 H.P. reversing motor, built as a double-armature machine to reduce its flywheel effect. A 325 H.P. motor drives the end rams. The motors are fed with direct current by a motor generator set of 4 units—a 1500 H.P. synchronous motor, 1000 kw. and 300 kw. generators for the large and small presses and a 50 kw. exciter. The generators are differentially compounded, the motors cumulatively compounded, the combination causing the press rams to move rapidly early in their stroke, and more slowly as the resistance of the ingot increases. WHB(8)

"Alumetier" Process of Coating Iron and Steel. (Die Alumetierung von Eisen und Stahl.) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 51, Jan. 12, 1930, pages 9–10.

The method described is an especially developed metal-spraying process by which material is first sprayed with an Al layer, then covered with an air tight substance and, finally, heated at a high temperature. Mention is also made of the so-called "fervalizing" which differs from the first process in that to the Al layer is added a coating of other metals in order to prevent the oxidation of the Al. (8)

Report of American Society for Testing Materials Sectional Committee on Zinc Coating of Iron & Steel. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 241–243.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 848. (8)

Hot Zinc Baths for Steel. WALLACE G. IMHOFF (Wallace G. Imhoff Co.) *American Machinist*, Vol. 73, Dec. 18, 1930, pages 962–964.

Standard specification for zinc requires that it contain less than 0.08% iron. Requirements of finished product varies content of bath. The more iron in the bath the heavier will be the coating deposited. New zinc and also tin tend to lighten the coating. Good zinc and aluminum lighten the coating but high iron content and low temperature will give a sticky coating. Tin tends to give a smooth coating. Brittleness may result from too high iron content, too low temperature, or too high metallic additions. RHP(8)

A Pure Zinc Galvanising Process. L. D. WHITEHEAD. *Ironmonger*, Vol. 191, Jan. 25, 1930, pages 64–65.

The advantages of electro-galvanizing over hot galvanizing of wire and strip are pointed out and a new process of electro-galvanizing is described. The important difference between the new and the old process of electro-galvanizing is in the use in the old process of galvanizing baths 60 to 80 ft. long which are costly to construct and difficult to keep liquor-tight. Photomicrographs are included showing the structure of coatings produced by hot galvanizing and by electro-galvanizing from which it is observed that the hot galvanized coating is not uniform in composition. Various methods of proving the efficiency of pure Zn have shown that electro-galvanized wire has a greater resistance to corrosion than hot galvanized products. (8)

Wire Galvanizing Processes. G. K. RYLANDS. *Ironmonger*, Vol. 191 May 3, 1930, pages 67–70.

The author replies to the criticisms of Whitehead (*Ironmonger*, Vol. 191, Jan. 25, 1930, pages 64–65) of the hot galvanizing process and presents the results of comparative tests of hot galvanized (Crapo Process) and electro-galvanized wire in gages 8, 10, 12 and 14 I. S. W. G. (8)

Electro vs. Hot Galvanising. L. D. WHITEHEAD. *Ironmonger*, Vol. 191, May 24, 1930, pages 65–69.

The author replies to the criticisms of Rylands (Ironmonger, Vol. 191, May 3, 1930, pages 67–70) and presents the results of microscopic examination and mechanical tests of electro-galvanized wire and hot galvanized wires of the ordinary British, Crapo and Continental types. (8)

Limitations of Cadmium and Zinc Coatings. Discussion. L. K. WRIGHT. *American Machinist*, Vol. 73, Dec. 11, 1930, pages 919–920.

Discussion on the article by K. A. Eckhardt in *American Machinist*, Vol. 73, page 429. Zinc is cheaper than cadmium. Where lightness is desired cadmium is used. Discusses relative merit of each and thickness of coating necessary. RHP(8)

INDUSTRIAL USES & APPLICATIONS (9)

Large Uses of Steel in Small Ways. Articles 157–169. *Iron Trade Review*, Vol. 86, Jan. 9, 1930, page 31; Jan. 23, 1930, page 34; Feb. 6, 1930, pages 81, 94; Feb. 20, 1930, pages 48, 62; Mar. 6, 1930, pages 89,92; Mar. 20, 1930, page 54; Apr. 3, 1930, page 83; Apr. 17, 1930, page 55; May 1, 1930, page 123; May 15, 1930, page 63; May 29, 1930, pages 58, 61; June 12, 1930, page 63; June 26, 1930, page 47.

Each article deals respectively with messenger call boxes; telephone booths; foot guards; springs; automobile lamps; power lawn mowers; furniture glides; luggage racks; shovels and spades; twist drills and reamers; health scales; windmills; and incinerators. MS(9)

Fabrication of Metal Stove Fronts. E. TONEY (Kawneer Co.). *Metal Stampings*, Vol. 3, April 1930, pages 367–369.

Outlines methods of constructing stove fronts from formed hollow metal sash and bars. Stamped metal ornaments are used. MS(9)

Spiral Springs for Spring-Driven Motors. E. C. WADLOW. *Engineer*, Vol. 150, Oct. 31, 1930, pages 474–476.

Deals with spiral springs such as are used in clocks, recording instruments, phonograph turntables and similar small mechanisms. Discusses torque, running time, motion of spring in barrel, stresses in spiral springs, energy losses in spring barrel, maintenance of constant speed of unwind and mechanical properties of spring material. For phonograph motors it is desirable to use steel of medium tensile strength. Following are properties of typical steel:

Limit of proportionality	88 tons/in.^{2}
Ultimate stress	116 tons/in.^{2}
Elongation in 2 inches	5%
Vicker pyramid hardness no.	560

An average value for modulus of elasticity of spring steel is 28 x 10^6 lbs./in.^{2} over stress range of zero to the yield point of about 85 tons/in.^{2} LFM(9)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Welding-On for Repair Purposes. Effect on the Basis Material. (Auftragsschweissung für Reparaturzwecke. Einfluss auf den Werkstoff der Unterlage.) M. SCHMIT (Gebr. Stork & Co., Holland). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 179–189. 8 references.

Repeated impact, tensile and bending tests show that either gas or electric welding injures the material of boiler plates. (11c)

Questions of Safety in Acetylene-Welding. (Sicherheits technische Fragen beim Azetylenschweissen.) ED. SAUERBREI. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74 Nov. 15, 1930, pages 1591–1595.

This paper discusses the causes of the formation of oxy-hydrogen in and near acetylene plants and the possibilities of ignition of explosive mixtures as well as the frequency of accidents. The entrance of air into the plant while charging, removing of sludge and renewal of water has to be given careful consideration. In many cases, ignition was caused by glowing carbide. About 42% of all accidents was due to backfiring from the flame at the burner. Special attention has to be given the proper sizes of burners and gas producers: often the burners are too large or the acetylene producers are too small. Above all, emphasis is laid on strict adherence to the safety rules which, as statistics show, are violated again and again. Ha(11c)

Automatic Control of the Wire Feed for Automatic Arc-Welding Installations. (Selbsttätige Regelung des Drahtvorschubes bei automatischen Lichtbogenschweissanlagen.) S. SANDELOWSKY. *AEG Mitteilungen*, Vol. 4, Jan. 1931, pages 1–7.

The quality of the welded seam depends on the sensitivity of the regulation of automatic advance of the welding rod. The electrical and mechanical conditions of several arrangements are discussed with regard to their possibilities of calculation and, based on these considerations, several welding-heads are numerically investigated. The sensitivity of the AEG welding head compared to 2 others is found to be 1000 : 10 : 4. Ha(11c)

Gas Cutting Steels and Their Alloys. E. WISS. Part I. *Welding*, Vol. 1, Jan. 1930, pages 154–158.

First of a series of 3 articles. A study of the effects produced on steels and their alloys by gas cutting. The heat effect of the gas cutting process is highest with heavy stock and varies with the composition of the steels; it is higher at the top surface of the cut (since the preheating flames travel over it) and is less at the bottom of the cut (except where the refuse material obstructs the bottom of the kerf, thereby trapping the heat); it is greater on thinner plates that are hand cut than machine cut. Gas cutting refines the grain structure of the face. Gas cut surfaces of Ni steels show a marked in-increase in the Ni content; Ni is more influenced by the heating effect than any other alloy. There are metallographic sections and tables of the properties of the structural steels tested, of the depth to which the influence of gas cutting extends, of the increase in C content of gas cut surfaces, of the changes in content of various alloy elements, of the increase in Ni content of gas cut surface. W(11c)

Progress in Oxy-Acetylene Cutting. (Fortschritte im Autogenschneiden.) A. WIEGAND. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1585–1590.

In a great number of examples, the progress of oxy-acetylene cutting and welding is illustrated. Cutting burners, cutting apparatus and machines are described and the advantages are pointed out. Ha(11c)

Procedure Control in Aircraft Welding. H. L. WHITTEMORE, JOHN J. CROWE & H. H. MOSS. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 140–146.

Discussion appended. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. (11c)

Welding and Soldering of Nickel and Copper-Nickel Alloys. (Ueber Schweissen und Löten von Nickel und Kupfer-Nickel-Legierungen.) M. WAEHLERT. *Apparatebau*, Vol. 42, Feb. 7, 1930, pages 27–31.

Directions for welding Cu-Ni alloys are given. (11c)

Welding for Repair Purposes. (Auftragsschweissung für Reparaturzwecke.) J. TITSCHER (Bundesbahnhauptwerkstätte, Linz, Austria). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 168–178.

General description of methods used with 17 photos of repair jobs. HWG(11c)

Welding Corrosion-Resistant Steels. E. J. TANGERMAN. *American Machinist*, Vol. 73, Sept. 18, 1930, pages 485–487.

Summary of interviews with several men and other material from several of the larger steel companies. The three methods now in favor are: oxy-acetylene, atomic hydrogen, and electric arc. The latter is usually the cheapest. Despite a high coefficient of expansion good welds are possible in corrosion resistant alloys. Suitable flux is important. Fluxes should have a high solvent power for the oxides formed. Gives instructions for welding several types of steel and special instructions as to the use of each method of welding. RHP(11c)

Some Notes on a "Burned-on" Casting. L. W. BOLTON. *Bulletin British Cast Iron Research Association*, Jan. 1931, pages 342–343.

Bureau Report No. 68 describes physical and microscopic tests of a 1½ inch thick gray iron casting, which had an almost circular hole about 3 inches in diameter filled in by burning on new metal. (11c)

Fabrication of Stainless Sheet Steel and Monel Metal. M. E. OLSEN (Mojonnier Bros.). *Metal Stampings*, Vol. 3, April 1930, pages 347–348.

From paper read before Chicago Section, American Welding Society. See *Metals & Alloys*, Vol. 1, July 1930, page 632. MS(11c)

Calculation of Arc-Welded Seams. (Kalkulation lichtbogengeschweisster Nähte.) H. v. NEUENKIRCHEN. *Schmelzschweissung*, Vol. 9, Dec. 1930, pages 275–276.

The author discusses the consumption of time, electrode material, and electric current for producing a given welded joint. Simple formulas for the calculation of required amount of electrode material to be melted are developed and a few examples illustrate the method. Ha(11c)

Large Engineering Laboratory Is Entirely Arc-Welded. *Electric Journal*, Vol. 28, Jan. 1931, page 40.

The Central Engineering Laboratories building of Westinghouse Elec. & Mfg. Co., at East Pittsburgh is believed to be the largest building built exclusively with arc welding. WHB(11c)

Spot-Welding Machine with Adjustable Pressure. *Electrical World*, Vol. 96, Nov. 22, 1930, pages 978.

The American Transformer Co., Newark, N. J., is manufacturing a spot-welding machine with quick-break contactors and adjustable-pressure mechanism. The welder is known as "Amer Tran" type B-5 and has a semi-automatic device which opens the primary circuit at will and permits the weld to freeze under pressure, preventing arching at the electrodes. The machine may be used for welding Cu and brass, resistance soldering and other applications requiring heavy pressure. The welder is bench-type and operates from a standard 220-volt, 50–60 cycle circuit and is available in 5, 7½ and 10 kva. sizes. WHB(11c)

Republic's New Mill Electric Welds 10 Miles of Pipe in 24 Hours. *Iron Age*, Vol. 126, Aug. 14, 1930, pages 422–424.

Electric welded steel pipes, ranging in diam. from 8⁵/₈ to 16 in. are produced. Preparation of skelp. Quick application and dissipation of heat in welding operation is to prevent abnormal grain growth near the weld. Advantages claimed for welding method. VSP(11c)

Welded Gasometer. (**Geschweisster Gasbehälter.**) *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, page 1564.

Contains brief data on a container of 6000 m.³ for the Gas Works of Olten, Switzerland, height 25.7 m., diameter 23 m., weight of structure 183 tons. The stationary parts and roof of the bell are electrically welded. Ha(11c)

Tube and Pipe Welding. *Sheet Metal Industries*, Vol. 4, Dec. 1930, pages 702–703.

Methods of eliminating excessive penetration, which interferes with the free flow of material through the pipe, are taken from a paper by M. R. Meslier which was presented at the International Welding Congress at Zurich. They are as follows; slightly expanding the ends to be joined, forming a socket at one end, fitting a short length of tube over the joint, and fitting a thin sheet steel sleeve inside the joint. The last method is considered best by the writer. AWM(11c)

Electric Welding of Steel Towers. (**Elektrisches Schweissen von Stahlgittermasten.**) *Schmelzschweissung*, Vol. 9, Dec. 1930, pages 283–285.

Describes the construction of towers for a 20,000 volt transmission line which was entirely welded electrically; they could be made in 30% less time than riveted towers. Ha(11c)

New Atomic Welding Machine is Automatic. *Canadian Mining Journal*, Vol. 52, Jan. 16, 1931, page 79.

An atomic hydrogen welding machine has been marketed by the Canadian General Electric Co., Ltd. It is designed for longitudinal seam welding of all kinds and consists of a clamping mechanism for holding the work, an automatic travel carriage, a welding head, and the usual control devices. Alloys containing chromium, aluminum, silicon or manganese can be welded without fluxes and without surface oxidation. WHB(11c)

Welding Torch Extends Use of Electric Arc. *Electrical World*, Vol. 97, Jan. 10, 1931, page 124.

The K. L. Hansen Engineering Co. Inc., Milwaukee, Wis. has developed an arc torch which utilizes the current from a d. c. welding generator, and has electrodes of specially constructed carbons. The positive electrode is given a peculiar channel shape and has a small aluminum core running through its entire length, and the negative electrode has the usual cylindrical shape but one end is tapered to a fairly sharp point. With the two carbons mounted in a suitable holder so that they are inclined at the proper angle, a flame which has been found well adapted to both brazing and welding is projected past the positive electrode. The absence of a blowing effect minimizes the convection heat losses. In brazing copper and copper alloys with the Hansen arc torch the same flux is used as when brazing with the oxyacetylene flame. WHB(11c)

The Fusion Welding of Pressure Vessels. *Engineer*, Vol. 150, Oct. 10, 1930, page 393.

Editorial commenting on "Technical Report for 1929" issued by the British Engine Boiler and Electrical Insurance Company, Ltd. Report discusses progress made in Switzerland in the practice of fusion welding, strength of plate for use in welded pressure vessels, use of atomic hydrogen process of welding, effect of composition and covering of the electrode on the quality of weld obtained, and effect of increasing Mn content of electrode covered with high-grade flux. Large section of report deals with tests made to determine cause of contaminated structures found in welds. LFM(11c)

Unusual Welding Jobs in Ford Fabrication. *American Machinist*, Vol. 73, Oct. 9, 1930, pages 586–588.

Welding methods used for various parts of the Ford motor car. Second of a series of articles on welding in Ford plants. The first appeared in *American Machinist*, Vol. 73, Oct. 2, 1930, pages 537–539. RHP(11c)

Gas-Welding Copper. *American Machinist*, Vol. 73, Nov. 20, 1930, pages 819–820.

Copper in the process of melting and casting absorbs oxygen. Rolling scatters these specks of oxygen throughout where they do not greatly influence fracture. The heat of welding causes the oxide specks to collect along the grain boundaries of the base metal adjacent to the weld which causes a zone of weakness. Completely deoxidized copper will remedy this. The copper should contain 0.05 to 0.15 silicon. A similar copper welding rod may be obtained. Welds of this type have about twice the ultimate strength and elongation as copper containing 0.01 to 0.08% oxygen. RHP(11c)

Welded Tanks. Parts V & VI. *Sheet Metal Industries*, Vol. 4, Oct. 1930, pages 487–488; Dec. 1930, pages 697–698.

Differences in welding wire quality and resulting welds are noted. Observation tests on the wire are described in detail. Simple tests on the physical properties are outlined and the value of first class, dependable welding wire is stressed. AWM(11c)

Welded Pressure Vessels in England. *Welding*, Vol. 1, April 1930, pages 378–382.

Discusses the regulations for fusion welding of pressure vessels issued by the British Boiler and Electrical Insurance Co., Ltd., Manchester, England. Includes a table showing various types of joints and their efficiencies for this work. ACW(11c)

Are Pressure-Welds More Reliable than Fusion Welds? (**Sind Pressschweissungen zuverlässiger als Schmelzschweissungen?**) W. Zimm. *Schmelzschweissung*, Vol. 9, Dec. 1930, pages 269–271.

Tests which have been made with heated pressure-welds indicate that manually made pressure-welds are to a much greater extent dependent on chances and disturbances than fusion welds. The opposite view cannot be maintained. Small plants especially should only rely on and use fusion welding. Several photomicrographs show the reasons for accidents which must be ascribed to an unreliable manual process. Ha(11c)

Comparison of Welded and Riveted Joints. F. P. McKibben (General Electric Company). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 155–162.

Length of welded fillets necessary to give the same strength joints as with rivets of different sizes are worked out by test, and tabulated. HWG(11c)

The Effect of Contamination by Nitrogen on the Structure of Electric Welds. L. W. Schuster. *Engineering*, Vol. 130, Oct. 24, 1930, pages 538–540; *Electrical Review*, Vol. 107, Oct. 24, 1930, pages 710–711.

Condensed from a paper read before the Iron & Steel Institute, Prague, Sept. 15–16, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 10. LFM+MS(11c)

Electrically Welded Pipe for High-Pressure Water Ducts. (**Elektrische Geschweisste Druckrohrleitung.**) Sonderegger. *Elektrotechnische Zeitschrift*, Vol. 51, Dec. 11, 1930, page 1727.

Description of details in electrically welding a water duct for the Italian hydro-power station Terni-Galleto which has a diameter of 4 m. and a thickness from 10 to 31 mm.; the total height is 190 m. All sections and bends are electrically welded. Ha(11c)

WORKING OF METALS & ALLOYS (12)

Casting & Solidification (12b)

Ingots and Ingot Moulds. Andrew McCance. *Journal West of Scotland Iron & Steel Institute*, Vol. 37, Mar. 1930, pages 101–119.

In dealing with the heat exchanges and the temperature fluctuations, which take place during casting and solidification, and where the specific heats for molten steel and solid mold are different, then the true mean temperature as well as its variation with the temperature of the mold, when plotted, give a rising straight line. The mean temperature may become high enough to produce a local melting of the molds. But in actual practice a layer of air is entrapped between the layer of scale of the ingot surface and the rough surface of the mold. This condition prevents both the molten steel and the mold in coming in intimate contact. When the cooling is too slow the result is a greater heterogeneity of the steel in the ingot. After solidification is complete, the distribution of the heat follows a mathematical expression of heat. The rate of heat absorption by the mold is very rapid during the first few seconds: it falls off quickly, then more slowly to a steady rate, and it is independent of the wall thickness. There are 3 distinct types of crystal growth formed on solidification of an ingot. The first periods exist for the first few seconds when the most rapid heat exchange takes place. The second period results in the formation of columnar crystals, lasting for about 5 minutes from the commencement of the teeming. The last stage is brought about when the rate of heat abstraction falls below 4 cal./sec. the crystals formed now being equiaxial. Slow teeming, by heating the inner surface of the mold and by enabling a thicker ingot skin to form, eliminates the cracking of ingots. Turning now to a consideration of the steel ingot it will be seen from tables No. 1 and No. 2, that the temperature of the outer skin of the ingot in its mold, when there is an air gap present, is approximately constant after the first few minutes and is in the neighborhood of 1100° C.

TABLE 1

Effect of Air Gap in the Ingot and Temperature of Mold

Air Gap mm.	Temp. liquid steel ° C.	Temp. Ingot skin ° C.	Temp. of mold inner surface ° C.	Temp. of mold outer surface ° C.
0	1500	930	930	530
0.10	1500	995	865	512
0.25	1500	1040	820	500
0.50	1500	1044	783	487
1.00	1500	1102	758	480
2.00	1500	1116	744	476

TABLE 2

Effect of Scale on Surface and Air Gap

1 mm. scale assumed on both ingot skin and inner surface of mold.

Air Gap	Temp. steel ° C.	Temp. Ingot scale ° C.	Temp. Mold scale ° C.	Temp. inside mold ° C	Temp. outside mold ° C.	Temp. skin ° C.
0	1500	930	930	863	509	997
0.10	1500	988	872	812	496	1048
0.25	1500	1031	829	774	486	1086
0.50	1500	1065	795	743	478	1118
1.00	1500	1084	773	724	469	1136
2.00	1500	1104	756	710	465	1150

Mathematical treatment of the rate of ingot solidification and the formation of piping show a point not hitherto recognized, that a low temperature of casting will minimize the formation of V segregates by limiting the movement down the central portion of the ingot, and it explains the disappearance of the V segregates at the bottom portion. As the taper is increased there is a rapid decrease in the amount of the piping as shown by the mathematical calculation of the inverted taper mold. GTM(12b)

Cause of Corner Ghost in Steel Ingots. Soji Maita. *Rolling Mill Journal*, Vol. 4, May 1930, pages 245–246.

Abstract of paper read before Iron & Steel Institute, May 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 737. MS(12b)

The Present Status of Casting Silumin. (**Der heutige Stand des Giessens von Silumin.**) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 51, Apr. 6, 1930, pages 57–59; Apr. 13, 1930, pages 62–63.

Silumin, known in America and France as Alpax is an Al alloy containing 13% Si. Its advantages over other Al alloys include lighter weight, better mechanical properties, excellent casting qualities and corrosion resistance. Casting, machining methods and uses of silumin are briefly discussed. (12b)

Casts Unusually Large Nickel-Chrome Retort. *Iron Trade Review*, Vol. 86, March 20, 1930, page 53.

Driver-Harris Co. cast a retort 48 in. in inside diameter, 60 in. deep, with a central chimney 12 in. in diameter. It is part of a special furnace the American Gas Furnace Co. is constructing for the Timken Roller Bearing Co. The retort weighs over 4000 lbs. Special steel flask was made to take the dry sand mold. Exceptionally heavy risers were provided, these having about half the weight of the casting itself. The high Ni-Cr alloy used was poured at 2900° F. MS(12b)

Mold Coatings. (**Anstrichmittel für Gussformen.**) Fritz Beitter. *Stahl und Eisen*, Vol. 5, Dec. 11, 1930, pages 1741–1744.

Report 197 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The article gives a general discussion of the benefits derived from the application of mold washes, especially the improvement of the surface of the ingots. The advantages and disadvantages of various mold washes, graphite coatings, aluminum coatings and tar-asphalt lacquers are pointed out. Reference is made to the various practices used in applying these coating materials. GN(12b)

Casting of Ingots from Aluminum Alloys. (**Das Giessen von Walzblöcken.**) P. Schwerber. *Giesserei-Zeitung*, Vol. 27, Feb. 1, 1930, pages 61–67.

The material has the strength of cast or forged steel but only ⅓ of the weight. It is believed that these light alloys have all the desired properties of heavier metals with the great advantage of light weight. Methods of melting and casting ingots with special reference to duralumin are described. (12b)

Rolling (12c)

Application of Tapered Roller Bearings to Rolling Mill Service. F. Waldorf (Timken Roller Bearing Co.). *Rolling Mill Journal*, Vol. 4, June 1930, pages 283–290.

Improved methods of making load determinations and the increase of other bearing information have made it possible to develop standardized mountings for several types of mill rolls. Describes some typical standard mountings for roll necks and points out interesting features of some special mountings to show the versatility of such bearings. MS(12c)

Measuring the Steam Consumption of a Rolling Mill. (Dampfverbrauchs-Messungen an einer schweren Walzenstrasse.) HELMUT WEISS. *Stahl und Eisen*, Vol. 50, Dec. 4, 1930, pages 1705–1708. 3 references.

Report 80 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. The steam gage of Hallwachs and Langen, Bensheim, Germany, proved most suitable for the determining of the power consumption of individual passes of a heavy steam-driven rolling mill running on billets, beams, rails and ties. In evaluating the results, conclusions could be drawn as to the improvement of the design of the passes. Furthermore, reliable data could be accumulated on the relation between rolling temperature and power consumption. GN(12c)

Modern Reversing Mill Drives. R. H. WRIGHT. *Iron & Steel Engineer*, Vol. 7, May 1930, pages 210–217.

The author reviews modern practices in applying electric drives to reversing mills and describes the general construction of modern reversing equipment. (12c)

Progress in Manufacturing Rails. (Neuere Fortschritte auf dem Gebiete der Schienenerzeugung.) W. SCHAEFER. *Stahl und Eisen*, Vol. 50, Nov. 6, 1930, pages 1567–1573.

The article considers Coutheaux's rolling method for manufacturing rails with heads with small amounts of segregations and the equipment for improving rails by quenching the surface. The methods of Sandberg, of the plant Neuves Maisons and the method of the Maxhütte are described and illustrated. The first 2 methods improve the wear resistance by obtaining a sorbitic structure of the surface; the latter method obtains the very hard martensitic structure in the surface. Reference is also made to the improvement of rails by using alloy steels and to the fabrication of compound rails, which are made by using 2 types of steel with different tensile properties. In this method, the harder steel is used for the head and the softer for the web and foot. GN(12c)

Effect of Rolling on the Properties of α-Brass. (Einfluss des Walzgrades auf die Eigenschaften von α-Messing.) N. DAVIDENKOW & W. BUGAKOW. *Metallwirtschaft*, Vol. 10, Jan. 2, 1931, pages 1–6.

Contains 15 references. α-brass strips 2 mm. thick, containing 62.95% Cu and 37.03% Zn, were annealed 1 hour at 550° C. and rolled to obtain 0 to 80% reduction in thickness. Tensile strength, yield point, elongation, Brinell hardness, solubility in 25% HNO_3 were determined, and micro and X-ray structure examined. With reductions from 0 to 20% the physical properties increase proportionately. From 20 to 30% they remain constant, in the case of hardness decrease, and above 30% increase again. The curve for solubility is similar to the physical properties. The micro and X-ray structure does not change up to 20% reduction, but from 30% up the crystals become elongated and assume a definite orientation. The critical range between 20 and 30% is explained by the existence of internal residual stresses. After annealing the rolled test pieces at 200° C. the increase in tensile strength is steady without any critical range. The residual stresses were measured by painting one side of 35 mm. long test pieces which had been reduced by rolling and dissolving the outside layer of the other side in HNO_3. The degree of bending due to the residual stresses was measured with a Zeiss optimeter in 0.001 mm. A maximum stress was found with 30% reduction in rolling. CEM(12c)

Piercing Action in the Manufacture of Seamless Tubes. K. SIMONEIT. *Rolling Mill Journal*, Vol. 4, May 1930, pages 247–248; July 1930, pages 375–378.

Translation of the abstract in *Stahl und Eisen*, Vol. 50, Feb. 6, 1930, pages 174–175, of the article by F. Körber and K. Simoneit in Mitteilungen aus dem Kaiser-Wilhelm Institut für Eisenforschung zu Düsseldorf, Vol. 11, pages 353–371. For abstract of this see *Metals & Alloys*, Vol. 1, Sept. 1930, page 737. MS(12c)

Investigation of the Resistance of Deformation of Low Carbon Steel in Hot Rolling between 700 and 1200° C. (Versuche über den Formänderungswiderstand und den Formänderungsverlauf beim Warmwalzen von kohlenstoffarmem Flussstahl im Temperaturbereich von 700° bis 1200° C.) E. SIEBEL & E. FANGMEIER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 159, pages 225–244. See also Resistance to Deformation and Flow of Material in Rolling. (Formänderungswiderstand und Werkstoffluss beim Walzen.) E. SIEBEL. *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1769–1775.

A low C steel was used for the tests (C: 0.08). In order to study the influence of the rolling temperature, as well as of other conditions on the resistance to deformation, the square bars (30 mm.) were rolled at each temperature with a varying relation between diameter of the roll and height of the bar. This relation is called "Stärkenverhältnisse." The relation amounted, in group 1, to 11.2% (20 to 178 mm.); group 2: 5.6% (10 to 178 mm.); group 3: 2.8% (5 to 178 mm.). Five different reductions were also used in every group. Group 1: 10, 8, 6, 4, 2 mm., corresponding to a reduction of 33%, 28%, 23%, 17% and 9%. Group 2: 10, 8, 6, 4, 2 mm., corresponding to a reduction of 50%, 44%, 37%, 28%, 17%. Group 3: 5, 4, 3, 2, 1 mm., corresponding to a reduction of 50%, 44%, 37%, 28%, 17%. In every group, the rolling temperatures used were 700°, 800°, 900°, 1000°, 1100° and 1200° C. The relation between reduction and resistance to deformation have been established first for the above "Stärkenverhältnisse." The temperature curves of group 1 show a gradual increase. At the low reductions, the velocity of recrystallization seems to be so small that strain hardening occurs even at the highest rolling temperatures used. The 900° C. curve is the steepest, indicating that the resistance to deformation of austenite close to the A_3 point is lower than the resistance to deformation of the α-iron at 800° C. at the high reductions. In groups 2 and 3, no increase of the resistance to deformations is shown at 1000°, 1100° and 1200° C., when the reduction is greater than 30%. Also in these groups, it has been found that the resistance to deformation decreases when the transformation γ-to α-iron takes place. This result is clearly demonstrated when the resistance to deformation is plotted against the temperature. It was furthermore found that the resistance to deformation, under similar conditions, increases with the decreasing "Stärkenverhältnisse." The tests check with static and dynamic deformation tests by M. Hennecke. The results are compared with the results of J. Puppe on the power consumption of blooming mills. A satisfactory agreement is found. The studies on the spread and the slip between the rolls and the material point to an increase of the friction with decreasing temperature. Also these results are in agreement with findings of Puppe on the same subject. GN(12c)

Machining (12g)

General Motors Experience with Tungsten-Carbide Cutting Tools. *Iron Age*, Vol. 126, Oct. 23, 1930, pages 1141–1142, 1201–1202.

Abstract of paper read before the Society of Automotive Engineers at Detroit by W. H. McCoy on the future development of tungsten carbide as a cutting tool. An increased size of tip is advocated to care for heat developed and to prevent temperature rising high enough to cause alloying with metal cut. Machining strains should be removed before applying tungsten carbide. Predicts many different grades of cemented tungsten carbide. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 43. VSP(12g)

Grinding Effects Economies in Dressing High-Speed Tools. *Iron Trade Review*, Vol. 86, May 8, 1930, page 55.

Treadwell Engineering Co., Easton, Pa., has effected marked savings in time and costs by substituting grinding for hand-forging in the dressing of high-speed tools in sizes up to $1^1/_4 \times 2^1/_4$. Larger sizes are difficult to handle. Use Bakelite bond wheels. MS(12g)

Steel Castings and Their Machinability. (Stahlguss und Zerspanbarkeit.) A. WALLICHS & K. KREKELER. *Giesserei*, Vol. 17, Apr. 4, 1930, pages 325–329.

Steel castings of to-day are subjected to thorough tests to determine their machinability. Includes an account of tests carried out by the Aachen machine tool laboratory on standard steel castings and on Ni and Ni-Cr alloys. The influence of melting and of C and Si content are considered. (12g)

Turning, Boring, Facing, Planning Manganese Steel. *Edgar Allen News*, Vol. 9, Sept. 1930, pages 707–708.

Note illustrating the correct use of the proper tools. W(12g)

The Accuracy of Gear Teeth. *Engineer*, Vol. 150, Nov. 7, 1930, page 517.

Discusses tests made at the National Physical Laboratory to determine accuracy of gear wheels produced by different manufacturing methods. Two classes of wheels were tested, those produced by various machining processes and were left soft or hardened after being machined, and those which were machined and hardened and subsequently finished by grinding. A pantograph was used to trace tooth profile on smoked glass. A perfect gear wheel should give record consisting of perfectly parallel equally spaced tooth contours. Conclusions drawn from these tests place gear wheels in following order of descending accuracy: (1) wheels finished by grinding with formed abrasive wheel, (2) wheels finished by grinding with a generating process, (3) wheels cut with specially selected backed-off milling cutters, (4) hobbed wheels, (5) wheels cut with rack or other form of generating cutter. Profile diagrams are reproduced. LFM(12g)

Tungsten Carbide Circular Saws Used on Various Materials. C. M. THOMPSON (Henry Disston & Sons). *Iron Age*, Vol. 125, June 19, 1930, pages 1823–1824.

Taken from paper on "The Application of Tungsten Carbide to Circular Saws" presented at the semi-annual meeting of the American Society of Mechanical Engineers at Detroit. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 737. VSP(12g)

Cutting Pressures and Power Consumption of "Widia" Tools. *Engineer*, Vol. 150, Dec. 26, 1930, pages 699–700.

Compares power consumption figures for cemented tungsten carbide with those obtained by the Cutting Tools Research Committee of the Institution of Mechanical Engineers. Comparison is also made with Ripper and Burley's figures for high-speed steel. Author has plotted curves from figures obtained from various investigators. LFM(12g)

Users of Tungsten Carbide Report Variety of Experiences. FRANK C. SPENCER (Western Electric Co.). *Iron Trade Review*, Vol. 86, June 19, 1930, pages 73–75.

Progress report of the Subcommittee on Tungsten carbide cutting materials of the American Society of Mechanical Engineers. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 852. MS(12g)

Testing the Machinability of Free Cutting Steels. (Die Prüfung der Zerspanbarkeit von Automatenstahl.) A. WALLICHS & H. OPITZ. *Archiv für Eisenhüttenwesen*, Vol. 4, Nov. 1930, pages 251–260; *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1779–1780.

Twelve different free cutting steels were subjected to a light cutting test to determine whether or not there is a relationship between machinability and tensile strength as it was previously established for structural steels. The cutting capacity, the condition of the machined surface and the formation of the chips were tested. It was found that an interrupted cutting does not impair the cutting properties of the tool. The total cutting time corresponds to the individual cutting times for each individual step. Cutting depth and feed have practically no influence on the produced amount of chips in automatic machining. The smoothness of the machined surface primarily depends on the shape of the chip. The authors observed 3 distinct types of chips: the tear chip, the shear chip and the flow chip. The flow chip is the most favorable as regards cutting capacity of the tool and the smoothness of the surface. Increasing cutting speed gives a smoother surface. The surface condition furthermore depends on the angles of the tool. The above results hold also in cutting threads. In examining the physical properties and the structure of the 11 steels tested, no relation between tensile strength and machinability could be established. GN(12g)

New Tool and Die Steels Give High Production. OWEN K. PARMITER (Firth-Sterling Steel Co.). *Iron Trade Review*, Vol. 86, April 17, 1930, pages 52–54.

Second part of a paper read before the Columbus Chapter of the American Society for Steel Treating, April 8, 1930. For first part, see *Metals & Alloys*, Oct. 1930, page 802. The most recent development in die steels is a Cr-Mo-V steel which has the advantage of ease in machining as compared with the older high Cr-high C die steels, at the same time retaining and improving the outstanding features of the type. Its composition is: 1.40–1.70% C, 0.15–0.30% Si, 0.20–0.40% Mn, 12.00–14.00% Cr, 0.50–1.00 Mo, 1.00–1.50% V. Forging and heating temperatures with resultant hardnesses are as follows:

Operation	Temperature range ° F.	Approximate hardness, Brinell No.
Forging	1700–1900	—
Annealing	1725–1760	200
Preheating	1200–1300	—
Hardening in air	1800–1875*	650
Hardening in oil	1780–1850*	650
Drawing	300–1000	650–600

* Smaller sections should be hardened at lower end of range and larger sections at upper end.

This steel has given excellent service as plug gages, rolls, lathe centers, bushings, and spinning tools, and is particularly valuable in machining non-ferrous metals, such as brass and bronze. In dies, it possesses about 7 times the life and efficiency of C steel and at least double that of high-speed steel. Outlines evolution of high-speed steel. A new super high-speed steel was introduced in 1926. It contains 0.75–0.90% C, 0.20% Si, 0.25% Mn, 17–22% W, 4.50–6.00% Cr, 1.00–2.50% V, 8–15% Co, 0.75–1.50% Mo Special practice is necessary in making this steel. The high-frequency furnace aids in obtaining uniformity. Forging and heat treating temperatures with resultant hardnesses are as follows:

Operation	Temperature range ° F.	Approximate hardness, Brinell No.
Forging	1650–2100	—
Annealing	1600–1700	250
First preheat	1200–1300	—
Second preheat	1700–1800	—
Hardening	2425–2500	650
Drawing	1050–1150	625–675

MS(12g)

Tungsten Carbide for Automotive Tooling. *American Machinist*, Vol. 73, Dec. 4, 1930, pages 883–886.

Description of the machining and grinding equipment of the plant of the Nash Motors Co. RHP(12g)

Comparative Machining Tests of "Schwaben-stahl" and Ordinary Screw Stock. (Vergleichende Bearbeitungsversuche zwischen dem "Schwaben-stahl" und gewöhnlichem Schraubenstahl nach DLN St. C 35.61.) R. Schöpf. *Mitteilungen aus dem Forschungsanstalten des G.-H.-H.-Konzerns*, Vol. 1, Nov. 1930, pages 33–34.

Tests to show the alleged superiority of a certain grade of screw stock made by the Schwabische Hüttenwerke. HWG(12g)

Cemented Tungsten Carbide as Applied to Cutting Tools. L. J. St. Clair. *Engineer*, Vol. 150, Dec. 26, 1930, pages 715–716.

Condensed from paper read before the American Society of Mechanical Engineers, Dec. 1930. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 44. LFM(12g)

The New Alloys and Machine Tool Design. Francis W. Shaw. *Metallurgia*, Vol. 3, Dec. 1930, pages 57–58, 61; Jan. 1931, pages 91-92, 96.

Reviews development of cutting tools, with emphasis on high-speed steel, Stellite and the WC alloy Widia. Points to improvement made in cutting tools by reducing Fe content, and predicts development of Fe alloy tools containing less Fe than high-speed steel. JLG(12g)

Drawing & Stamping (12h)

Table for Estimating Sheet Metal Bends. *American Machinist*, Vol. 73, Dec. 25, 1930, page 1015.

Formula and table calculated from it used in die shops for calculating 90° angle bends. RHP(12h)

Production of Automobile Body Stampings. *Metal Stampings*, Vol. 3, March 1930, pages 261–264.

Describes methods of the Studebaker Corporation of America. MS(12h)

"Necking-in" Drawn Shells—Discussion. Carl E. Schinman & Chester B. Lord. *American Machinist*, Vol. 73, July 3, 1930, pages 21–22.

Discussion by Mr. Schinman of an article in *American Machinist*, Vol. 72, page 68. Mr. Lord replies and adds to the original article. RHP(12h)

Steels for Cold Pressing. G. R. Bolsover. *Iron & Steel Industry & British Foundryman*, Vol. 4, Dec. 1930, pages 101–102.

Low carbon rimming steels used for deep drawing do not work-harden readily. The tensile strength varies approximately as one third the percentage reduction in steel thickness. When the steel is stretched more than 5% brittleness is encountered on reheating to 200° to 300° C. Age hardening after quenching increases the tensile strength of dead mild steel 67%. For deep drawing purposes stainless steel must be low in carbon and should be quenched from a high temperature. CHL(12h)

Cold Working (12j)

Procedure for Monel Metal and Nickel Tanks and Tank Linings. *Sheet Metal Worker*, Vol. 21, Oct. 31, 1930, pages 657–660.

Practical suggestions are made as to good workmanship in forming, edging, jointing and seaming of Monel metal. GN(12j)

Contribution to the Study of Cold Rolled Steels. (Contribution a l'Etude des Aciers étires á froid.) G. Delbart. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Nov. 1930, pages 483–508.

Cold rolled steels heat treated to temperatures up to 700° C. were studied. In studying the physical properties of carbon steels at different temperatures, there was noted a fall in tensile strength at a temperature in the neighborhood of 650°–700° C., and the same was true for Brinell hardness. Resistance to corrosion in sulphuric acid is minimum for steel annealed at 700° C. while a favorable effect takes place on magnetic properties at this temperature. GTM(12j)

Cold Work, Physical Properties of Metals. R. L. Templin (Aluminum Company of America). *Heat Treating & Forging*, Vol. 16, Mar. 1930, pages 338–342; condensed in *Metal Stampings*, Vol. 3, Apr. 1930, pages 343–344.

Paper read before the American Institute of Mining and Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. MS(12j)

Cleaning (12k)

Efficiency of a Cleaning Solution. Edw. L. McIlhenny (Cowles Detergent Co.). *Metal Cleaning & Finishing*, Vol. 3, March 1930, pages 210–212.

From paper read before American Ceramic Society, Feb. 15–21, 1930. Outlines action of cleaning solution, gives hints on making the solution and addition of cleaner. Describes an application of the water-break test for determining the exhaustion point of the tank contents. MS(12k)

Scale and Oxide Removed Rapidly by Electrochemical Process. *Iron Age*, Vol. 126, Sept. 25, 1930, pages 860–861.

Describes the Bullard-Dunn Electrolytic process for cleaning metals. Scales, oxides, grease and dirt are removed from metal surfaces by the action of H, electrically generated on surface of metal beneath the scale or oxide. A feature of the process is the protection of the surface from pitting, etching and embrittlement by the H. The acid electrolyte used is made up of 3 oz. of H_2SO_4, 3 oz. of HCl and 3 oz. of NaCl per gallon of water. The alkaline electrolyte is made up of 3 oz. of Na_2CO_3, 4 oz. of $Na_3PO_4 \cdot 12H_2O$ and 9 oz. of NaOH per gallon of H_2O. VSP(12k)

Cleaning of Metal. Pt. I–X. Robert W. Mitchell (Magnus Chemical Co.). *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 13–18; Feb. 1930, pages 111–114; March 1930, pages 207–210; April 1930, pages 299–304; May 1930, pages 389–394; June 1930, pages 485–488, 493–494, 512; July 1930, pages 585–590, 598; Aug. 1930, pages 673–680, 684, 688; Sept. 1930, pages 759–762, 766; Oct. 1930, pages 839–847.

Includes bibliographies. Discusses the influence of the degree of alkalinity and colloidal action on the efficiency of cleaners; buffering action of cleaning compounds; colloidal action; properties of soaps and other washing colloids; surface tension of common liquids, solutions, and colloidal solutions, and their relation to detergent action; properties of soap solutions and their interfacial tension against oils; adsorbing and emulsifying power of soap solutions; and measurement of hydrogen-ion concentration, buffer action, and detergent action of cleaning solutions. MS(12k)

New Process for Removing Scale from Steel. *Brass World*, Vol. 27, Jan. 1931, page 8.

The Hanson-Van Winkle-Munning Co., Mattewan, N. J., has introduced an electrolytic bright dip. Steel is treated in an acid bath as a cathode and in a second acid bath as anode with a water rinse between. Hydrogen embrittlement is eliminated in all work except highly tempered steel with thin sections, like springs and hacksaw blades. Embrittlement that cannot be prevented is overcome by boiling in water for a few minutes, or by baking at moderate temperature, after scale is removed. Operation may be full-automatic or semi-automatic. The process is inapplicable where this sheet strips or wire unable to carry the current required are involved, also for steel, iron or malleable castings which have a "skin" containing silica inclusions. Deep recesses necessitate inside anodes, at times, for best results. WHB(12k)

Preparation of Automobile Bodies for Lacquer Finishing. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 49–51.

Steel bodies in the plant of the Graham-Paige Motor Car Co., are given a preliminary wiping with oleum spirits. Rusted areas are rubbed with an abrasive and are spotted with a material similar to the spray material. The bodies are then sprayed with a patented composition containing H_3PO_4, colloidal clay fillers and solvents, having the consistency of paint. They are passed through an oven heated to 225° F., time taken being about 16 min. The dry coating is removed from the sides by metal bristle brushes. Steel shavings are used to remove the cleaner from the front end and back panels. MS(12k)

Polishing & Grinding (12l)

Polishing and Buffing of Stainless Steel. C. C. Snyder (Central Alloy Steel Co.). *Metal Cleaning & Finishing*, Vol. 2, April 1930, pages 313–316.

For most flat work, grinding should be started with No. 80 to 120 grit wheels, usually dry. Artificial abrasives are recommended up to No. 200 and black emery from No. 200 up. The No. 120 abrasive should be followed up by No. 150 and then by No. 180. For a mirror finish, it is necessary to continue with 200 abrasive and grease, then flour emery, followed by buffing. Drawn shapes are polished on a cushion type or soft wheel coated with No. 150 artificial abrasive using grease, at a speed of 6000 ft./min. This is followed by 180 abrasive with grease, No. 200 block emery with grease and finally 3 F flour sized emery. A stainless steel buffing compound on a cushion or soft type buffing wheel at a speed of 7200–8200 ft./min. is used for buffing. A color buff with Cr_2O_3 is then used. Bars and tubes, after having scale removed by pickling, are polished by means of a polishing belt. No. 60 or 80 dry artificial abrasive is used as a start. This is followed by 120, dry, and then 150, with grease. MS(12l)

Polishes Radiator Shells on Automatic Machine. *Steel*, Vol. 87, July 3, 1930, page 69.

Ford Motor Co. uses automatic machines to polish corrosion-resistant steel radiator shells. Machine consists of 2 principal units, the overhead mechanism for rotating and traversing the polishing wheels, and the conveyor on which are located fixtures of the indexing type for holding the work. Peripheral velocity is 9000 ft./min. For rough polishing, wheels set up with No. 120 manufactured Al_2O_3 are used, followed by No. 150 wheels, both being worked dry. Finishing is done with wheels set up with No. 120, 180 and 200 Turkish emery. The last 2 wheels are greased. Buffing is done on a machine similar to those used for polishing. MS(12l)

Polishing and Buffing of Automobile Hardware. *Metal Cleaning & Finishing*, Vol. 2, Jan. 1930, pages 21–22.

Describes practice of Oakland Motor Car Co. Radiator shells are rough polished on a No. 120 emery wheel at 2000 r.p.m. They are then polished with a 10 in. rag wheel coated with No. 150 abrasive, followed by using a 12 in. sheepskin wheel coated with No. 220 abrasive, with grease as lubricant. Ni plate is buffed with a 14 in. rag wheel, using a white lime buffing compound, at 2200–2400 r.p.m. Cr deposit is buffed with a special Cr_2O_3 grease compound, using a rag wheel at about 2500 r.p.m. Rustless Fe is buffed with a special 8 in. rag wheel at 3000 r.p.m. Abrasive is a Cr_2O_3 compound, lubricated with kerosene. MS(12l)

Coloring (12m)

Color Finishes of Aluminum. *American Metal Market*, Vol. 38, Jan. 21, 1931, page 10.

By treatment in a solution of certain chemical salts under carefully controlled conditions, aluminum shingles are given a durable shade of gray. Brown shades are also obtainable. Oxide coatings electrochemically deposited on the article acting as anode are becoming prominent. Anodic oxidation in chromic acid produces a coating of high corrosion-resistance and is widely used on aircraft parts of the duralumin type alloys. In a special solution an oxide film with strong affinity for certain types of organic dyes is produced. The coating may be dyed in an almost infinite variety of colors. An oxide film 0.0004 inch thick possesses an abrasive resistance 5–10 times as great as 5 coatings of baked enamel. A thickness of 0.0002 inch is sufficiently flexible not to crack with ordinary bending of the sheet. WHB(12m)

Filing (12o)

Burs and Files and Aluminum Castings. *American Machinist*, Vol. 73, Oct. 23, 1930, pages 669–671.

Describes filing machines and processes used in filing aluminum products in Fairfield, Conn. plant of Aluminum Company of America. RHP(12o)

Spinning (12p)

Spinning Gruss Air Spring Dome Heads on Steel Tubing. *Iron Age*, Vol. 126, Oct. 30, 1930, pages 1224–1225.

Dome head made on large sections of steel tubing by expanding and spinning the metal while hot. Tube is made into cylindrical sleeve which is a sliding inner member in the Gruss air spring used on motor buses and trucks. Method and equipment were developed by the Cleveland Pneumatic Tool Co. VSP(12p)

ECONOMIC (16)

Rare Metals. Cobalt, Molybdenum, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1929. Paul M. Tyler & Alice V. Petar. *Mineral Resources of the United States*, 1929—Part I, pages 79–116, *United States Bureau of Mines*, December, 1930.

In 1929 the United States produced no Co. Patents and technical developments are covered in abstracts of 15 references. Mo ore and concentrates produced in 1929 contained about 4 million lbs. of metallic Mo, an increase of 17% over 1928. Patents and technical developments are indicated in abstracts of 24 references. Columbite production (Ta), all by one company, decreased from 34,899 lbs. in 1928 to 22,117 lbs. in 1929. Developments in technology are shown by abstracts of 12 articles and 7 patents. The production of Ti is not given. General conditions in the industry are discussed and abstracts of 31 articles are appended. Sales of W dropped in 1929 to 830 tons of concentrate carrying 60% WO_3. Details of domestic and foreign production are discussed. Articles (24) and patents (21) issued during 1929 are abstracted. Domestic and foreign developments in the production of Ra and U are described and supplemented by abstracts of 22 articles. The consumption of V in the United States in 1930 is estimated at 1,800,000 lbs. Over 90% of the world's supply is under American industrial control, but only about 16% of it occurs in deposits within the United States. 6 articles and 5 patents are abstracted. AHE(16)

Forging Costs Cut by Systemization. H. R. Simonds. *Iron Trade Review*, Vol. 86, Jan. 23, 1930, pages 27–30.

Account of the plant and forging practice of the Spicer Mfg. Co., South Plainfield, N. J. MS(16)

PLANTS & LABORATORIES (17)

Design and Construction of a 750/850 mm. 2-High Mill of the Dortmunder Union. (Entwurf und Bau einer 750/850er Duostrasse der Dortmunder Union.) J. MEISER. *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, pages 1633–1638.

Report 79 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. After discussing the reasons for the construction of the new mill a detailed description is given of the mill, including all supplementary machinery such as cranes, Siemens-regenerative pusher furnaces, saws, shears, cooling beds, etc. The rolling program of the mill consists of billets, slabs, beams, angles, rounds, squares, flats, light rails and special profiles such as sheet piles. The average tonnage/18 hrs. amounts to 750 tons. Under favorable conditions, a maximum tonnage of 1100 tons can be rolled for certain profiles. GN(17)

Develops Grain Flow Control. J. B. NEALEY. *Iron Trade Review*, Vol. 86, June 12, 1930, pages 57–60; *Heat Treating & Forging*, Vol. 16, July 1930, pages 905–907; *Fuels & Furnaces*, Vol. 8, June 1930, pages 773–778.

Champion Machine & Forging Co., Cleveland, Ohio, manufactures automotive and aircraft drop forgings. Billets are heated uniformly throughout the entire cross-sectional area to 2100°–2300° F., in a reducing atmosphere. The hot steel is placed skillfully in the various dies and the hammering is so regulated as to cause the grain to flow along the lines previously determined and blue printed by the forging engineers. The forgings are normalized at 1575°–1625° F., reheated to just above the critical temperature, cooled in the furnace or in the air, reheated to above the critical temperature again, quenched in oil or water, and drawn at 1000°–1200° F. MS(17)

Foundry Pours 4000 Tons Monthly. J. B. NEALEY. *Iron Trade Review*, Vol. 86, May 22, 1930, pages 51–54.

Describes the No. 1 foundry of the Allis-Chalmers Manufacturing Co., Milwaukee, which is used for heavy castings. Parts are molded continuously. All pouring is direct from cupola to flask. MS(17)

Apparatus Saves Foundry Labor. J. B. NEALEY. *Iron Age*, Vol. 126, Aug. 14, 1930, pages 418–421, 446.

Describes modernization of 2 foundries of Allis-Chalmers Mfg. Co., Milwaukee. Metal is produced in 6 cupolas. One of these is for chilled Fe. More than 4000 tons of metal is poured monthly in this foundry, while No. 2 foundry has a capacity of 2500 tons. For tractor parts a continuous molding unit is used. Insulated core ovens are employed. Firing is by means of two-pipe system. VSP(17)

Furnaces for the Carburizing Department. J. B. NEALEY. *Machinery*, Vol. 37, Sept. 1930, pages 25–26.

A carburizing compound has been developed by the Tool Steel Gear & Pinion Co. which is said to give uniform hardness throughout the depth of the case which ranges from $^3/_{16}$ to $^1/_4$ in. Most of the steel used is 0.15 to 0.20% C steel. After carburizing, the surface contains 0.90 to 1.20% C. Surface hardness 90–100 scleroscope. Furnaces used are of car-bottom type and can be used interchangeably for carburizing and other heat treatments. Gas is used for fuel. Describes the furnaces. One is a new type. It is brick steel encased, heated with 6 gas-blast burners, 3 on each side, car-bottom type, 9 ft. wide, 14 ft. deep, 10 ft. high. Top of car is of refractory, material, with piers, on the top a series of rails with notches at close intervals. Alloy steel tubes support the work and rest in these notches. Burners fire under the tubes. One large door in the front which is locked by a cam on each side. RHP(17)

Strip Steel Mill of the Acme Steel Co. J. B. NEALEY. *Blast Furnace & Steel Plant*, Vol. 18, Aug. 1930, pages 1277–1279.

Describes equipment in the strip mill at Riverdale, Ill., with special reference to the lead annealing pots, galvanizing and japanning installation, and slab furnaces. MS(17)

Strip Steel Annealed, Galvanized and Japanned Continuously. J. B. NEALEY (American Gas Association). *Iron Age*, Vol. 126, Oct. 2, 1930, pages 919–925.

Describes plant of Acme Steel Co., Chicago. Most interesting feature is an installation which takes a strip of steel and anneals, cools, pickles, washes and galvanizes it continuously, automatically and at high rate of speed. VSP(17)

Inland—A Midwestern Steel Company. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 153–164, 169–177.

Description of the blast-furnaces, coke-ovens, open-hearth furnaces, rolling-mills and other equipment of the Inland Steel Co., Indiana Harbor, Ind. MS(17)

Demonstration of Confidence in Research. R. S. MCBRIDE. *Chemical & Metallurgical Engineering*, Vol. 37, June 1930, pages 352–353.

Describes the research laboratory of the Aluminum Company of America, especially from the point of view of chemical engineering research. See article by Richard Rimbach, *Metals & Alloys*, Vol. 1, Sept. 1930, pages 717–720. MS(17)

Forge Shop Design Results in Efficient Operation. R. H. ALLEN. *Iron Trade Review*, Vol. 86, May 15, 1930, pages 47–50, 57.

Description of the lay-out and equipment of the Lefere Forge & Machine Co., Jackson, Mich. Has 12 oil-forging forging furnaces heating stock to 1600° F. MS(17)

The Basic-Bessemer Steelworks of the Mannesmann Tube Works. J. POSTINETT. *Iron & Coal Trades Review*, Vol. 121, Sept. 5, pages 326–327.

Taken from *Stahl und Eisen*. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 854. RHP(17)

The Cardiff Blast Furnace Plant of the British Iron & Steel Company Limited. *Iron & Coal Trades Review*, Vol. 121, Aug. 1, 1930, pages 151–153.

Describes and illustrates the equipment of the plant. Discusses capacity, charging gear, hoists, gas-cleaning, stoves, casting equipment and blowing plant, boiler plant and raw materials used. RHP(17)

Electro-Galvanizing at Oakfield Steel-Wire Works. *Iron & Coal Trades Review*, Vol. 121, July 18, 1930, pages 77–79.

Describes the plant of the Whitehead, Hill & Company, Ltd. Deals with equipment and methods used in galvanizing steel wire. RHP(17)

Plant for Making Large Steel Castings. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, April 1930, pages 622–623, 626; *Heat Treating & Forging*, Vol. 16, April 1930, pages 484–486.

Describes plant and equipment of the Ohio Steel Foundry Co. at Lima, Ohio. MS(17)

Tube Mill of the Laclede Tube Company. CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 18, May 1930, pages 781–783, 824.

Illustrated description of the equipment for and methods of manufacturing butt welded tubes of Bessemer and open-hearth steel. Annual capacity is 45,000 tons. Includes galvanizing and enameling facilities. MS(17)

Heat-Treating Furnaces Distributed in Line of Machine Shop Production. H. E. SCARBROUGH. *Iron Age*, Vol. 126, Aug. 7, 1930, pages 357–359.

Describes installation of General Electric furnaces of total connected load of 2745 kw. for Caterpillar Tractor Co. Furnaces are placed in line to facilitate the addition of other units in case of expansion. Leeds & Northrup temperature control instruments are used. Plant will average between 8 to 10 lbs. of heat treated parts/kwh. VSP(17)

Steel Foundry Specializes in Railroad Castings. NORMAN F. HINDLE. *Foundry*, Vol. 58, June 15, 1930, pages 42–47; July 1, 1930, pages 113–116.

Describes plant of Scullin Steel Co. specializing in production of side frames and bolsters. There specialties absorb 90% of foundry tonnage. Remainder of metal is used for car, locomotive and miscellaneous castings such as sugar mill machinery, rolls, gears, propellers, etc. VSP(17)

Ovens for Drying Crank Case Cores. *Heat Treating & Forging*, Vol. 16, April 1930, pages 512–513.

Studebaker Corporation, South Bend, Ind., has installed equipment which consists essentially of a monorail conveyor on which the cores are conveyed in racks through a 4-pass, 2-compartment continuous core-oven. The ovens are heated by one down-draft induced draft heater, each compartment being supplied by an independent fan operated from a common mixing chamber. Cores are dried by hot air at temperatures of 500°–700° F., depending upon the load. There are hot zones in each oven compartment. Each compartment handles 170 cores, each weighing 26 lbs., per hr. Drying time is 3 hrs. Cores after being black washed are dried in the black-wash oven, which is located directly under the core-oven, and is heated by air exhausted from the core-oven. Average gas consumption for 100 cores is 2200 cu. ft. of 530 B. t. u. gas. MS(17)

Welding Revolutionizes Manufacturing. *Iron Age*, Vol. 125, June 19, 1930, pages 1818–1820, 1868.

Describes how manufacturing methods at Bauer Brothers Co. have been revolutionized by the application of welding. Foundry and machine shop have been replaced by shear, punch and welding departments. Machining is reduced to a minimum. VSP(17)

Columbia Steel Corporation Operations. W. R. PHIBBS (Columbia Steel Corp.). *Mining & Metallurgy*, Vol. 11, April 1930, pages 205–206.

Read before Utah section of the American Institute of Mining Engineers, Jan. 9, 1930. Ore used is shipped from Desert Mount, Utah. It is a hematite disseminated with magnetite. Screening the ore and charging into furnace in layers of the sand size has resulted in decrease of coke consumption. Koppers Becker-type coke ovens are used. The by-products produced are ammonium sulphate, tar and motor fuel. The highest volatile coal is used and the coke is fast and free-burning. The company owns mills at Pittsburgh, Pa., and Torrance, Cal. VSP(17)

British and Continental Open-Hearth Furnace Steel Works. H. C. WOOD. *Engineering*, Vol. 130, Sept. 19, 1930, pages 373–377; Oct. 3, 1930, pages 447–448. Discussion, page 417.

Condensed from paper read before the Iron & Steel Institute, Prague, Czechoslovakia, Sept. 16, 1930. LFM(17)

A Modern Industrial Research Laboratory. *Machinery*, Vol. 36, Aug. 1930, pages 949–950.

Describes the new research laboratory of the Aluminum Company of America at New Kensington, Pennsylvania. RHP(17)

The Metallurgical Laboratories of the Ontario Research Foundation. R. RIMBACH. *Metals & Alloys*, Vol. 1, Nov. 1930, pages 816–818.

Ontario Research Foundation is endowed to the extent of $3,800,000 for pure and applied research. The work is now in progress in behalf of the textile industries, the packing industries and the metallurgical industries. The structure arrangement and facilities are described and photographs shown to clarify the description. ESC(17)

Machine Paced Founding. *American Machinist*, Vol. 73, Nov. 20, 1930, pages 811–814.

Description of the foundry of the Caterpillar Tractor Co., Peoria, Ill. RHP(17)

Research Building Designed for Broad Use of Steel and Aluminum. *Iron Age*, Vol. 126, Oct. 23, 1930, pages 1149–1150.

Describes new research and engineering building now being constructed for the A. O. Smith Corp., Milwaukee. VSP(17)

Interesting Oven Installation at Wright Aeroplane Plant. *Fuels & Furnaces*, Vol. 8, April 1930, pages 500–504, 512.

Description of installation in the foundry of the Wright Aeronautical Corp., Paterson, N. J., consists of oil-fired, continuous core baking oven; gas-fired closet model ovens for pasting and blacking cores; electric aging and drawing oven; oil-fired ovens for heating castings prior to welding; electric continuous type oven for shrinking heads on cylinders; 2 compartment electric japanning oven; and 3-compartment electric enameling oven. MS(17)

Extremely Large Furnaces Used in the Manufacture of Aluminum Structural Shapes. *Fuels & Furnaces*, Vol. 8, May 1930, pages 637–638, 646.

Installation at the Massena, N. Y. plant of the United States Aluminum Co., consists of 4 coke-fired open-hearth furnaces for melting pig Al; electrically heated furnace with 14 pits for preheating the ingots to 850°–950° F.; oil-fired, conveyor-type, billet heating furnace; electric heat-treating furnace, 90 ft. long, inside dimensions, with 26 zones; and a steam-heated aging oven, 90 ft. long, inside dimensions. MS(17)

Modern Equipment Saves Time and Labor in New Foundry. *Iron Age*, Vol. 126, Sept. 25, 1930, pages 836–839.

Describes new equipment in the Charles City, Iowa Foundry of the Hart Parr Division of the Oliver Farm Equipment Co. VSP(17)

Produces Bars or Bands at 2000 Ft. a Minute. *Iron Age*, Vol. 126, Aug. 28, 1930, pages 558–559, 598.

Describes the Inland Steel Company's new merchant bar mill at the Indiana Harbor Works. VSP(17)

Tractor Plant Foundry Built for Mass Production. *Iron Trade Review*, Vol. 86, May 22, 1930, pages 57–60.

Brief description and illustrations of the foundry of the Caterpillar Tractor Co., Peoria, Ill. MS(17)

A Cluster Mill for Brass Strip. The New Plant of Emery Brothers, Ltd. *Metal Industry*, London, Vol. 37, Aug. 8, 1930, pages 125–126.

A description of the plant. VSP(17)

A German Electrolytic- Precious Metal Refinery in America. (Eine deutsche Electrolyt-Edelmetallschmelze in Amerika.) GEORG NICOLAUS. *Deutsche Goldschmiede-Zeitung*, Vol. 33, Dec. 13, 1930, pages 578–580.

Describes plant of the Irvington Smelting and Refining Co. at Newark, N. J. JLG(17)

Fabricating Pressure Vessels with Forge Welding. THEODORE R. OLIVE. *Chemical & Metallurgical Engineering*, Vol. 37, July 1930, pages 412–415.

Describes roll and hammer processes at American Welding Co., Carbondale, Pa. MS(17)

Decentralized Heat-Treating Equipment. FRANK J. OLIVER. *American Machinist*, Vol. 73, Sept. 25, 1930, pages 511–513.

At the plant of the Caterpillar Tractor Co., Peoria, Ill., the heat treating equipment is scattered throughout the various buildings, being placed nearest the production machinery upon which the work to be treated is turned out. Much of the equipment is designed and built by the Caterpillar engineers to suit their requirements. Describes the equipment and layout. RHP(17)

Laboratory of Dignity and Beauty. E. E. THUM. *Iron Age*, Vol. 26, July 17, 1930, pages 162–164.

Describes new research laboratory of the Aluminum Co. of America at New Kensington, Pa. VSP(17)

MACHINERY & SUPPLIES (18)

Electric Welding Equipment. *Electrical Review*, Vol. 107, Oct. 17, 1930, pages 652–655; Oct. 24, 1930, pages 707–708.
Descriptions of various British manufacturers' products now available. MS(18)

Chipping Billets with a Novel Machine. A. K. West. *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1461–1462.
Description of a machine developed by the Bonnot Company, Canton, Ohio. It can be used to chip billets of any cross-section and any length up to 30 ft., without the necessity for any adjustments. MS(18)

MISCELLANEOUS (20)

Heating Elements. *Electrician*, Vol. 105, Nov. 28, 1930, pages 677–679.
An abstract from a contribution by the Research Dept. of Steatit-Magnesia A. G., Berlin, Germany on the causes of destruction of Cr-Ni resistance wires. Results of a recent research are given. Deliberate overloading of the resistance wire until it burnt out was attempted to permit study of the results. Chromium trioxide was formed by purely thermal reactions and the oxide mist migrated. The phenomena encountered in practice was reproduced in the laboratory and studied. The well known burning out of heating elements is caused by the wire. The colored deposits occurring so extensively without the chemical or electrolytic coöperation of the ceramic material serve as a proof that overheating has taken place. Where radiating heat is involved a glowing temperature of 900° is sufficient and resistance wires and strips heated to much lower temperatures should be employed where only low-temperature heating is required. If an arc occurs on the burning out of the heating wire the ceramic element is also injured by the action of the oxides. The actual conductivity at high temperatures of the ceramic material is less important than generally believed. Resistance to temperature change is due to design and shape as well as material. WHB(20)

Change in Structure of Copper Due to Plastic Deformation. C. H. Mathewson & Kent R. Van Horn. *Metal Stampings*, Vol. 3, June 1930, pages 547–548, 556.
From paper read before American Institute of Mining & Metallurgical Engineers. See "Directed Stress in Copper Crystals," *Metals & Alloys*, Vol. 1, May 1930, p. 527. MS(20)

Simplified Shell Design Effects Economies in Wire Wheel Manufacture. *Metal Stampings*, Vol. 3, Feb. 1930, pages 167–169.
Comparison of former and present operations employed in the forming and machining of hubs for wire wheels, at the plant of the Wire Wheel Corporation of America. MS(20)

Modern Plant for the Utilization of Blast Furnace Slag for Road Construction. (Neuzeitliche Anlage zur Verarbeitung von Hochofenschlacke zu Teerstrassen-Baustoff.) *Stahl und Eisen*, Vol. 50, Dec. 11, 1930, pages 1752–1753.
The new plant built by the Vereinigte Stahlwerke, Division August Thyssen Works–Duisburg-Hamborn is described in detail. The plant is built for a production of 80 tons of tar-macadam/hr. GN(20)

Chrome-Nickel Steel Symbols Standardized. *American Machinist*, Vol. 73, Dec. 25, 1930, page 1028 b.
List of symbols agreed on by 51 companies producing chrome-nickel steels under license by the Krupp Nirosta Co., New York. RHP(20)

Chemical Removal of Incrustations. *Engineering & Mining Journal*, Vol. 131, Jan. 26, 1931, page 64.
The chemical process described has been in use in many European mining companies for some times. The equipment consists of a small centrifugal pump, a mixing tank, and pipe connections and fittings. A condenser with a capacity of 10 tons of cooling water requires a mixing tank of one ton capacity, to permit correct mixing and feeding of the compound which should contain 2400–3000 lbs. of HCl 24° Be. to each 10 tons of water. The mixture is circulated through the condenser. The mixing tank is filled 9 times with water which is discharged into the condenser and the mixing tank half filled with water. The bottled hydrochloric acid is added slowly to avoid a rapid rise in temperature and to prevent splashing. The compound is circulated till the incrustations have dissolved, which is easily determined. The muddy liquid is then drained through the nipple. Cleaning and repairing time has been reduced from 5 days to about 36 hours. WHB(20)

Tube Mill Equipment Automatically Lubricated. *Rolling Mill Journal*, Vol. 4, Aug. 1930, pages 411–414, 434.
Describes and illustrates applications of positive pressure lubricating units to the equipment in the seamless tube plant of Spang, Chalfant & Co., Inc., at Ambridge, Pa. Each unit consists of an air plunger directly connected to a grease plunger. Air pressure of 80–110 lbs./in.^{2} gives a grease pressure of 600–700 lbs./in.^{2} Changing length of stroke of piston changes amount of grease fed. Cycle of operations is automatically regulated by an electric time controller. MS(20)

Plastic Deformation. (Zur Frage der bildsamen Verformung.) R. Mitsche. *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, pages 1645–1646.
In order to study the plastic deformation of metals, a simple device was developed which allows the visual observation of the process of deformation on materials like clay or wax or paraffin. With these materials, the cast structure of high speed steels was stimulated so that the deformation of the various structural elements of such type of steel could be studied. GN(20)

Destruction of Metals by Insects. (Metallzerstörung durch Insekten.) Bauer & Vollenbruch. *Elektrotechnische Zeitschrift*, Vol. 52, Jan. 8, 1931, page 46.
See *Metals & Alloys*, Vol. 2, Feb. 1931, page 46. Ha(20)

The Development of Electrical Gas Cleaning in Industry. (Le development industriel de l'epuration electrique des gaz.) M. Leveque. *Revue de Metallurgie*, Vol. 27, Oct. 1930, pages 513–521.
The first industrial application of electrostatic precipitation was made by A. O. Walker in coöperation with Sir Oliver Lodge in 1885. In France, it is used in the present modification of Cottrell method for cleaning of blast furnace gas, carbon black precipitation and tin oxide fume recovery. The installation at Homecourt is described, where blast furnace gas is cleaned in 2 stages. The first installation takes care of 120,000 m.^{3}/hr. reducing its dust content below 100 mgs./m.^{3}. In the actual practice an average of 46.74 mgs./m.^{3} is obtained with the outside limits of 28.2 and 68 mgs./m.^{3} The second unit is designed to handle 60,000 m.^{3}/hr. and to reduce the dust content to less than 20 mgs./m.^{3} The gas leaving it contains on an average 14.5 mgs./m.^{3} of dust with the outside variations of 12.5 and 19.2 mgs./m.^{3} Energy consumption is practically the same for both units, being equal to 1.53 KWH/1000 m^3. of dry gas and 1.39 KWH/1000 m.^{3} of wet gas. 9 photographs of the installation are given and the plant described. JDG(20)

Reduction of Sulphur Dioxide. George J. Young. *Engineering & Mining Journal*, Vol. 131, Jan. 12, 1931, page 7.
J. W. Beckman reduced SO_2 with CO in the presence of a simple catalyst. A cylindrical chamber is heated by electrical means to maintain the contact mass at 800–1200°F. SO_2 mixed with natural gas or CO and passed through a contact mass discharges a gas from which elemental S condenses. The reactions are exothermic. Experiments have been confined to a laboratory scale. WHB(20)

The Physical Characteristics of Industrial Powders. H. Marshall. *Canadian Chemistry & Metallurgy*, Vol. 14, Nov. 1930, pages 314–316.
According to their mode of preparation powders fall into the following classifications: (1) ground igneous rocks or glasses and stamped metallic powders, (2) ground earths and rocks of softer types, (3) precipitated powders, and (5) sublimed powders and "fume" pigments. Points discussed include: wetting, the settling of powders from liquids, the theory of liquid films, emulsification of powders, adsorption phenomena, and the manufacture and packing of powders. A bibliography is appended. WHB(20)

On the Dezincification of Brass. (Ueber die Entzinkung von Messing.) G. Masing. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 23–25.
This paper was presented at the Annual Meeting of the Deutsche Gesellschaft für Metallkunde, Berlin 1930, and deals with the phenomenon of brass dezincification in service with emphasis on condenser tubes. After a scientific treatment of the nature of this process the author discusses the complete prevention by additions of arsenic. EF(20)

A New Arrangement for the Granulation of Blast Furnace Slag with Water and Air. (Eine neue Einrichtung zur Granulierung von Hochofenschlacke mit Wasser und Luft.) F. Spiess. *Stahl und Eisen*, Vol. 51, Jan. 1, 1931, pages 10–14.
Report 116 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The lack of sweet water at the blast furnace plant of the Koninklijke Nederlandsche Hoogovens en Staalfabrieken necessitated the development of a new method of granulating blast furnace slag. In a spout, the molten slag is mixed with small amounts of water. At the end of the spout cold air is blown through nozzles upon hot and voluminous slag, thus performing the final granulation. Data on the consumption of water and air are given as well as information on the properties of the sand which may be used for cement fabrication as well as bricks for construction. GN(20)

Dry Granulation of Molten Blast Furnace Slag. (Trockene Körnung von flüssiger Hochofenschlacke in Granuliermühlen.) P. Berger. *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1775–1778.
Report 115 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The article describes the equipment for the dry granulation of blast furnace slag; considers the cost of dry granulation and the properties of the sand obtained by this method of granulation. It is shown that an essential saving of coal is accomplished in producing a sand with a humidity of about 7%. This saving amounts to about 3 tons coal/1000 tons of granulated slag. GN(20)

The Lead Deposit Mirror. E. H. Bostock. *Brass World*, Vol. 27, Jan. 1931, page 9.
The lead-coated mirror is produced from lead acetate or nitrate with thiourea. Lead sulphide is deposited and has a rather dull bluish cast which deadens light reflections producing little or no glare. WHB(20)

How Steel Bends. C. B. Dean. *American Machinist*, Vol. 73, Oct. 9, 1930, page 585.
Gives lettered diagrams, and formulas based on these to find what allowance is to be made in flat sheet steel for bends. RHP(20)

Saw Making Fundamentals. S. Horace Disston (Henry Disston & Sons). *American Machinist*, Vol. 73, Nov. 6, 1930, pages 730–732.
Article is from an interview with S. Horace Disston. Considerable historical matter is given and some general material concerning present saw making at the Disston plant. RHP(20)

The Different Magnetic States of an Ion. G. Foex. *Transactions American Electrochemical Society*, Vol. 55, 1929, pages 97–103.
The ferrous ion has been found to occur in 3 distinct magnetic states. Measurements made with different samples of nickel sulphate ($NiSO_4.H_2O$) have, however, always given the value of 16 magnetons. (20)

Design of Castings. (Die Konstruktion von Gussstücken.) W. Schreck. *Giesserei-Zeitung*, Vol. 27, Mar. 15, 1930, pages 163–166.
It is shown that a large proportion of waste in castings can be traced to faulty design. Suggestions for proper design and construction are given. (20)

Safety Device to Avoid the Turning Over of Converters. (Sicherheitsvorrichtung gegen das Umschlagen von Konvertern.) E. Schwenzner. *Stahl und Eisen*, Vol. 51, Jan. 1, 1931, pages 17–18.
A simple counter balance safety device has been installed by the Demag Corporation, Duisburg, on the converters of the August Thyssen Plant—Hamborn of the Vereinigte Stahlwerke. GN(20)

Recovery of Small Amounts of Precious Metals with Zinc Sheet. (Rückgewinnung geringer Edelmetallreste mittels Zinkschrott.) Edmund R. Thews. *Deutsche Goldschmiede-Zeitung*, Vol. 33, Dec. 13, 1930, pages 580–581.
Ag and Au can be economically recovered from solutions by precipitation with Zn. Ag can be removed from solution more rapidly if the solutions are made slightly acid with HCl or H_2SO_4. To precipitate Au from cyanide solutions, the solution should be made acid. This is dangerous due to the liberation of HCN, but can be safely done if the solutions are first diluted with a large quantity of water. After the first precipitate is collected by filtration the last traces should be extracted by allowing the Zn to remain in the filtered solution for 24 hours. JLG(20)

A Model to Explain the Mechanism of Electrolysis. M. DeKay Thompson. *Metal Industry*, N. Y., Vol. 28, Aug. 1930, pages 384–385.
Paper presented before Electrochemical Society at St. Louis, May 29–31, 1930. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 741. VSP(20)

The Manufacture of Gold Leaf. George M. Whiley. *Brass World*, Vol. 26, Dec. 1930, pages 323–324.
A description of the age-old industry of Au beating, from the November 1930 Bulletin of the Birmingham (England) Jewelers' & Silversmiths' Association. To pure fine Au is added a certain proportion of alloy—usually Cu or Ag. The mixture is melted in a crucible and cast into an ingot or bar which is passed again and again between highly burnished steel rollers with ever increasing pressure and frequent annealing, until a "ribbon," 1¼ in. wide and 2 yds. to the ounce, is obtained. The ribbon is cut into square pieces, weighing 6 grains and placed between the leaves of a "crutch" (consisting of 200 sheets of fine vellum) measuring 4 in. square. WHB(20)

Application of Maintenance Inspection Schedules to Steel Plants. J. B. Whitlock (American Rolling Mill Co.). *Rolling Mill Journal*, Vol. 4, Apr. 1930, pages 173–174, 182.
Points out the value of regular inspection schedules for obtaining uninterrupted operation in all departments of steel plants, especially where straight line production methods are employed. These schedules are developed and applied by the maintenance department to every piece of equipment. MS(20)

FOUNDRY PRACTICE & APPLIANCES (22)

The Detroit Rocking Electric Furnace as Applied to the Production of High Test Gray Iron. CARL H. MORKEN. *Iron and Steel Industry & British Foundryman*, Vol. 4, Dec. 1930, pages 87–90.

Paper presented at meeting of the American Electrochemical Society, Sept. 25, 26, 27, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 15. CHL(22)

Pearlitic Cast Iron. H. J. YOUNG. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 45, 1929–30, pages 66–75.

Includes discussion. One can make an all-pearlitic iron with 3.2% total C, 0.25% P, 0.75% Mn by lowering Si, raising Si and increasing S, or adding Cr, or lowering Si and adding Ni. An iron may be on the cementite or the ferrite side of a true pearlitic structure without its being evident under the microscope. Analysis for combined C involves inaccuracies, so one never knows when he has a pure pearlitic iron. In the Lanz process, an iron of such composition is chosen that the center of the casting will just be all pearlitic when cast in a cold mold, the outer portion and the thinner sections would then be white or mottled. But the dry sand mold is heated to such a temperature that all parts of the casting cool at a rate slow enough to give the pearlitic structure. Young says the idea that there are peculiar properties in a given brand of pig iron, not shown by its complete analysis, is false, and that given any brand of pig or hematite iron, he can, by addition of steel scrap, ferro silicon or ferro manganese, produce straight cast iron of any known quality. In discussion, Hoskison, a pig iron producer, took issue with this statement. To reduce wear of a cast iron engine cylinder, the piston rings should not be softer than the cylinder wall. Debris from the wearing of soft rings causes more wear on the cylinder than a hard ring. HWG(22)

Report of American Society for Testing Materials Committee A-3 on Cast Iron, with Appendix. Report of Sub-Committee XIII on High Test Cast Iron. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 187–198.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 855. (22)

Melting Equipment for Aluminum. *American Metal Market*, Vol. 37, Dec. 16, 1930, pages 3, 12.

A bulletin by the National Smelting Co. discusses the type of melting equipment for foundries of small capacity and of large. Distinction is made between foundries with few alloy mixtures and those requiring a continuous supply of molten metal, and frequently having large runs of a single uniform alloy. WHB(22)

Standards for Copper Alloy Ingots. *Metal Industry*, N. Y., Vol. 28, Oct. 1930, page 479.

Revised tentative specifications for Cu base alloys in ingot form for sand castings, approved as tentative by the American Society for Testing Materials on Aug. 12, 1930, and by Non-Ferrous Ingot Metal Institute on Sept. 5, 1930. VSP(22)

Does Humidity Affect the Density of Red Brass Castings? N. G. NEAR. *Metal Industry*, N. Y., Vol. 28, Sept. 1930, page 416.

Observations show that during winter more difficulty is encountered in producing castings with less sponge than in other seasons. Factors responsible for spongy castings were eliminated. During winter, the moisture in atmosphere varied from 0.2 to 3 gr./ft.^{3}; during summer, from 3 to 16 gr./ft.^{3}. Metal melted during winter when steam is added to the air lines to supply the deficiency of moisture was found to be more dense and free from sponginess so prevalent otherwise. VSP(22)

The Founding of Bronze Gear Blanks. FRANCIS W. ROWE. *Metal Industry*, London, Vol. 36, June 27, 1930, pages 669–672; Vol. 37, July 4, 1930, pages 11–13.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 28. VSP(22)

A Riser. JOSEPH P. MCGINNIS. *Metal Industry*, N. Y., Vol. 28, Sept. 1930, page 423.

Describes a pattern for a bronze casting that is finished all over, with exception of bracket part. VSP(22)

Complexities in the Steel Foundry. FREDERICK A. MELMOTH (Detroit Steel Casting Co.). *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 1006–1008, 1014.

Address before the Steel Founders' Society of America. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 15. MS(22)

Getting the Most Out of Steel Castings. H. A. MITCHELL (Bonney Floyd Co.). *Iron Age*, Vol. 126, Oct. 2, 1930, pages 914–917.

Heat treated plain C steel has properties equal or superior to many types of annealed alloy steel castings. By heat treatment is meant quenching and tempering as distinguished from annealing. Best properties of steel castings can be brought out only by quenching and tempering. Effect of various heat treatments. Dangers of quench cracks can be eliminated as follows: (1) Metal must be thoroughly refined before casting; (2) Charge to be quenched must be at uniform temperature; (3) Temperature to which castings are quenched is important. Any type of steel casting in annealed state shows practically the same properties regardless of method of manufacture. Includes graphs and tables. VSP(22)

Alloy Cast Iron and High Strength Cast Iron in the United States of America. F. B. COYLE (International Nickel Company). *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 35–48.

Methods for production of high strength iron are, superheating in the electric furnace or the hot blast cupola, partial malleabilization of white iron, use of all steel scrap charge, graphitization of a white iron composition by addition of ferrosilicon and nickel in the ladle. The effects of addition of Ni and Cr are shown in modified Maurer diagrams which are given also in Coyle's article in Transactions American Society for Steel Treating, September 1927. HWG(22)

Improvement of Cast Iron by Alloying and Superheating. (Verbesserung von Gusseisen durch Legierung und Ueberheitzung.) E. SCHÜZ. *Mitteilungen aus den Forschungsanstalten des G.-H.-H.-Konzerns*, Vol. 1, Nov. 1930, pages 34–40.

Schüz claims that neither superheating nor alloying with Ni and Cr bring advantages to true cast iron corresponding to the cost. For true resistance to high temperatures (ability to stand 3 heatings to 1000°–1050° C. in gases of combustion of coal without losing over ½% by scaling) high Cr iron is useful. The dividing line between Fe-Cr alloys passing this test and those that do not, runs from 22½% Cr at 1% C to 19% Cr at 4½% C. However, in order to avoid proeutectic carbide these irons should not contain over 3% C. With carbon constant at 2½%, the line runs from 22% Cr at zero silicon to 14% Cr at 11% Si. A proper Si content tends to prevent cracking. Dilatometer curves are given to show the superiority of an iron with 2% Si over one of ½% Si, both with 25% Cr and 2% C. HWG(22)

High-Strength Cast Iron-Eutectic Cast Iron. E. OSANN. *Foundry Trade Journal*, Vol. 43, July 31, 1930, page 75.

Abstract translation of paper read before the German Foundry Technical Association. Discusses the advantages of eutectic alloys. VSP(22)

Malleable Iron Castings. (Temperguss.) B. OSANN. *Maschinenbau*, Vol. 8, Dec. 5, 1929, pages 785–789; Dec. 19, 1929, pages 832–834.

A discussion of melting, casting and annealing in pots and furnaces, cleaning and processing. Metallurgical processes, such as admixture of Mn, Si and S are considered, together with the causes of failures in annealing, strength qualities and the strength of malleable cast iron. (22)

Ratio of Metal Charged to Cupola Melting Speed is Important. W. N. TRUXELL (Potter Coal & Coke Co.). *Iron Age*, Vol. 126, Aug. 28, 1930, pages 544–555.

From an address before the Pittsburgh Foundrymen's Association, May 19, 1930. Weight of the metal charged in proportion to melting speed is the established variable. Cupola will not operate on a higher efficiency on steel than on Fe. Increasing metal charge decreased loss from spongy sections, and does not injure smaller castings. Melting point of steel scrap decreases as C content increases. Steel is used to make gray Fe stronger and tougher. VSP(22)

Melts Gray Iron for Stove Plate in the Electric Furnace. N. L. TURNER. *Foundry*, Vol. 58, Aug. 1, 1930, pages 88–89.

Advantages of continuous operation of electric furnace for this class of castings are as follows: (1) production of castings increased 25 to 30%; (2) cost of Fe at spout is less than previously obtained; (3) flexibility of the method. Ideal stove plate gray Fe analysis is within following ranges: C 3.25–3.35%, Si 2.75–2.85%, P 0.60–0.70%, Mn 0.45–0.60%, S less than 0.09%. Gives electric furnace cost for one month. Data procured from Black Foundry, Ltd., Ottawa, Canada. VSP(22)

Briquetting Borings Reduce Gray Iron Melting Costs. FRED J. WALLS (Wilson Foundry & Machine Co.). *Foundry*, Vol. 58, July 15, 1930, pages 68–70; *Foundry Trade Journal*, Vol. 43, July 24, 1930, pages 59–62; *American Machinist*, Vol. 73, Aug. 7, 1930, pages 245–249.

Abstracted from paper presented in behalf of the American Foundrymen's Association before the Institute of British Foundrymen, June 17–20, 1930. Of the various methods used for binding together cast Fe borings, the best results are obtained by compacting the borings under pressures into briquets which withstand rough usage without disintegrating. Gives cost figures and results obtained in melting varying amounts of briquets in the cupola. VSP+RHP(22)

Accurate Finish for Match Plate Patterns. PAUL H. WHITE. *Iron Age*, Vol. 126, Oct. 30, 1930, pages 1214–1215, 1277.

Describes method employed in making a match plate for an irregular shaped part. VSP(22)

Low Carbon Cupola Cast Iron. (Niedriggekohltes, schmiedbares Gusseisen aus dem Kupolofen.) W. VALENTIN. *Giesserei-Zeitung*, Vol. 27, Nov. 15, 1930, pages 617–621.

The article gives results of tests on cast Fe produced according to the Corsalli method. The C content could be essentially decreased, so that contents between 0.99 and 1.26 C were found. The structure of these cast irons does not show any free graphite. The tensile strength of sand cast Fe of this composition increases up to 50 kg./mm.^{2} In chilled and annealed castings of this composition, a tensile strength up to 97 kg./mm.^{2} was observed. GN(22)

The Economic Utilisation of Compressed Air in Steel Foundry Practice. T. W. BARLEY. *Foundry Trade Journal*, Vol. 43, July 17, 1930, pages 39–40; *Edgar Allen News*, Vol. 9, Dec. 1930, papes 765–768.

From a paper read before the Institute of British Foundrymen. The outstanding points to be considered to ensure economy in compression and use of air in foundries are: (1) Where possibly a central station should be installed and compressors of guaranteed output used; (2) Volume and pressure recorders for the air, and power recorders for prime movers; daily readings to be taken; (3) Test for leaks periodically; (4) High-grade oil to be used; (5) Valves and moving parts of air tools should have close attention. VSP(22)

FURNACES & FUELS (23)

A New Method for Regulating Electric Furnaces. (Un nouveau mode de règlage des fours électriques à électrodes.) PAUL BERGEON. *Journal du Four Electrique*, Vol. 39, June 1930, pages 209–211.

Instead of regulating the furnace by moving the electrodes, the voltage can be varied thus having the electrodes fixed all the time. The voltage is varied by the use of multiple taps in 56 different positions on the primary, giving a variation of from 24.18 to 56 volts for the secondary. Miguet and Perron furnaces are operated by varying voltage. GTM(23)

Electric Black Annealing Furnaces. (Elektrische Schwarzglühöfen.) H. LANGENBACH. *Elektrizitätswirtschaft*, Vol. 29, Jan. 1, 1930, pages 12–13.

Favorable results obtained with furnaces for annealing of polished stock have led to the electrification of coal-fired furnaces. Performance characteristics and economies in operation of this furnace are explained on the basis of production. (23)

Bright-Annealing by the Grünewald Process. R. W. MÜLLER. *Metallurgia*, Vol. 3, Dec. 1930, pages 69–70.

Translated from *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 525–527. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 49. JLG(23)

Conveyor Furnaces Heat Treat Small Parts. *Iron Trade Review*, Vol. 86, March 27, 1930, page 61.

Hevi Duty Electric Co., Milwaukee, has developed a furnace for quantity heat treatment of small automotive or machinery parts. Conveyor consists of a 3/16 in. woven-mesh belt of the floating reinforcement type, composed of heat-resisting Ni-Cr alloy wire. Belt is supported on driven rollers through the furnace chamber which imparts the driving impulse uniformly at closely adjacent points. No hearth plate is used. Furnace with a hearth 1½ by 12 ft. heats 1000 lbs. of parts an hour to 1550° F. MS(23)

Properties and Use of Zirconium Products. (Ueber die Eigenschaften und Verwendung von Zirkonerzeugnissen.) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 50, Sept. 8, 1929, pages 143–144.

The excellent refractory properties of Zr make it of special value for use in industrial furnaces. The compositions of a few Zr products are listed. (23)

Low-Pressure Steam Improves Drill Furnace Operation. *Engineering & Mining Journal*, Vol. 131, Jan. 26, 1931, page 54.

At the central drill-sharpening shop of the Copper Queen branch of the Phelps Dodge Corp. at Bisbee, Arizona, new oil-fired rock-drill furnaces feature the use of steam in place of air for combustion. Introduction of steam at 12 lbs. pressure results in a moist flame which effects a slightly reducing atmosphere within the combustion chamber of the furnace, preventing decarbonizing and scaling of the steel during the heating process. Air is used to start the furnace and to generate the necessary amount of steam. The method of using steam in the rock-drill furnace is shown by a chart. WHB(23)

Special Furnaces to Heat Treat Axles and Gears. *Iron Age*, Vol. 126, Oct. 16, 1930, pages 1061–1065.

Describes new heat treating equipment installed at the plant of the Eaton Axle & Spring Co., Cleveland. Axle shafts and gears and pinions for automobiles are heat treated in new continuous automatic gas-fired furnaces. Carburizing furnace is of the counter flow recuperative type. Gears and small pinions are made of 3.5 and 5% Ni steel. The 5% Ni steel is used mostly for drive and differential pinions. They are carburized at 1650° F. for 10 hrs. and remain in furnace about 24 hours. Suction system is used for cleaning carburized parts. Furnace for hardening gears is an electric double-deck continuous roller hearth furnace of 120-KW capacity. Gears and pinions made of 3.5 Ni steel are hardened at 1480° F. and those made of 5% Ni steel are hardened at 1460° F. Cleaning unit for removing scale and oil is feature of plant's equipment. VSP(23)

Electric Ovens for Aircraft Engine Parts. PHILIP KRIEGEL. *American Machinist*, Vol. 73, Dec. 25, 1930, pages 1007–1009.

Discusses types of electric ovens used by several aeroplane companies in the heat treatment of parts. Gives temperatures at which various parts are treated. RHP(23)

Source of Heat for Heat Treatment. ROBERT M. KEENEY. *Metals & Alloys*, Vol. 1, Oct. 1930, pages 755–759.

A general discussion is offered concerning the merits of bituminous coal, anthracite coal, powdered coal, fuel oil, butane, natural gas, city gas and electricity for heat treating. The latter 5 prove satisfactory for this purpose. An itemized analysis of the various units of auxiliary equipment is offered together with comment on the hazards. An oil fired furnace operates with a net efficiency of 7.1 to 17.0%; a gas fired furnace operates with an efficiency of 35%; and an electric furnace, with an efficiency of 72%. Considerable attention is devoted to furnace atmosphere such as CO_2, H_2, H_2O vapor, air, CO, CH_4, illuminants for hardening and drawing. In the matter of bright annealing, atmospheres of H_2O vapor, CO, H_2, N_2, and Electrolene are useful. ESC(23)

Design and Heat Utilization, Open-Hearth. *Blast Furnace & Steel Plant*, Vol. 18, Feb. 1930, pages 299–301.

From *Demag News*. Describes recent improvements in the Moll-Demag open-hearth furnace. Air and gas are mixed in a mixing chamber in much the same way as in a Bunsen burner. In the latest designs the air chambers are carried over the furnace platform on the outside ends of the furnace, resulting in a preheating of the air to 2550° F. The bulky, heavy port heads of the normal open-hearth furnace have been eliminated. Removal of slag from the regenerator chambers is facilitated by the substitution of removable slag boxes for the usual slag chambers. Gives results obtained with a Thyssen-type waste-heat boiler with smoke-tubes and superheaters. MS(23)

High and Low Pressure Air for Furnaces. C. F. OLMSTEAD (Mahr Manufacturing Co.). *Heat Treating & Forging*, Vol. 16, June 1930, pages 778–780, 785.

Shows that air from a fan or blower is more economical than that from a compressor, when used in oil burners and as a protecting curtain. Not only is there a saving in power costs, but the linings last 50% or more longer. Better heating of the steel is obtained with low pressure air. MS(23)

Blast Furnace Gas as a Metallurgical Fuel. JOSEPH F. SHADGEN (Smoot Engineering Co.). *Iron Age*, Vol. 126, Nov. 6, 1930, pages 1287–1789.

Blast furnace gas is the 3rd product of the process of reducing ore into pig Fe. Approximately 50 to 55% of heat content of coke charged with ore leaves furnaces in form of gas. Major uses of blast furnace gas are for: (1) stoves; (2) boilers; (3) metallurgical furnaces. Surplus gas available per ton of pig Fe is about 95,000 to 100,000 cu. ft. S is the most objectionable impurity in fuel. Producer gas is the standard fuel used in coke ovens, open-hearth furnaces, soaking pits, heating furnaces, etc. VSP(23)

Gas Mixtures for Multi-Fuel-Fired Furnaces. JOSEPH F. SHADGEN (Smoot Engineering Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1374–1375, 1436.

Surveys the field with regard to the principal available fuels and shows how a gas mixture of any desired heating value may be obtained by blending 2 or more common gases. Blast furnace and coke oven gases are used for all operations that have baseload characteristics. Producer gas and oil are best suited for peak load demand. Multi-fuel-fired furnaces should be equipped with apparatus to regulate air for fuels in addition to proper draft control for removal of waste gases. VSP(23)

Modern Methods of Testing Coke. (Neuzeitliche Verfahren der Stückkoks-Prüfung.) WOLFGANG MELZER. *Archiv für Eisenhüttenwesen*, Vol. 4, Nov. 1930, pages 225–238; *Stahl und Eisen*, Vol. 50, Nov. 27, 1930, pages 1675–1676.

Report 36 of the Coke-Plant Committee of the Verein deutscher Eisenhüttenleute. Next to the determination of the chemical composition of a coking coal, the determination of some physical properties are of importance in order to find a suitable application for any type of coke. This testing should include the determination of the reactivity, the porosity, the strength and the friability. For testing the reactivity, the inflammability was determined by means of the Bunte method which was improved for this investigation. Not only does the reactivity of individual coke particles vary, but also the reactivity of coke particles taken from various parts of a coke oven. It was found that the ignition point is dependent on the type in which the C of the coke is present. The porosity of the coke also changes within an individual piece as well as within an oven charge. The strength and friability were determined by the Simmersbach-drum method. The above 4 test methods permit the judging in any case of the suitability of various types of coke for different purposes. The blast furnace is the best practical indicator of the quality of a coke. GN(23)

The Testing of Coke Coals. (Die Prüfung der Kokskohlen.) WOLFGANG MELZER. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 169–175; *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, pages 1643–1644.

In order to qualify the coking qualities of coke coals, 3 different tests are applied in particular: the determination of the chemical structure of the coal; the determination of the chemical changes during the coking process; and the determination of the mineralogical structure. 20 different German coking coals were tested by these methods. GN(23)

High-Frequency Steel Furnaces. D. F. CAMPBELL. *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1625–1628; condensed in *Electrical Review*, Vol. 107, Oct. 3, 1930, pages 554–555; *Fuels & Furnaces*, Vol. 8, Dec. 1930, pages 1639–1641.

Paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 16. MS(23)

Metal Melting by Oil Fuel. W. C. CATHCART. *Foundry Trade Journal*, Vol. 43, July 31, 1930, pages 77, 80.

Crucible coke-pit fires have advantages of low first cost, and are suitable for producing varied range of alloys. The metal output for given floor space is low. Coke-fired tilting crucible furnaces permit the melting up to 1/2 ton with a saving in fuel and floor space. Producer gas is cheap on a cost per thermal unit basis, but gas making plant uses too much space and expert supervision is required. Electricity is too costly. Liquid fuel on the other hand was a high calorific value and it can be burnt in pit or tilting furnace. More metal can be melted in oil fired furnace. Oil firing is suitable for melting pure Ni, Ni alloys and Al, etc. Oil is fed to burners by gravity. Compares results of melting 70–30 brass in 1/2-ton crucible furnaces using coke and oil as fuel. VSP(23)

Open-Hearth Combustion. W. P. CHANDLER, JR. *Proceedings Engineers' Society Western Pennsylvania*, Vol. 46, Oct. 1930, pages 241–263; *Fuels & Furnaces*, Vol. 8, Aug. 1930, pages 1069–1072, 1105.

The author discusses a number of factors to be considered in the economical operation of an open-hearth furnace. The heat requirements of the open-hearth process, the types of fuels available, methods of increasing the flame temperature, the value of preheating the air and gas, furnace regulation and the design of ports are discussed. MS(23)

Insulation Improves Operation of Malleable Iron Annealing Furnaces. *Fuels & Furnaces*, Vol. 8, May 1930, page 716.

Arches of 3 pulverized-coal-fired furnaces at the Sacks-Barlow Foundries, Newark, N. J. were insulated, resulting in more uniform temperatures throughout the furnaces, and a saving in fuel of almost 20%. MS(23)

Electric Furnaces for Steel Metallurgical Works. (Fours électriques pour la métallurgie de l'acier.) *Genie Civil*, Vol. 96, Apr. 12, 1930, pages 349–352.

A description of several modern types of reverberatory arc furnaces, high-resistance furnaces. (23)

Some Points Pertaining to Heating. *Heat Treating & Forging*, Vol. 16, July 1930, pages 911–912.

From *World Power*. General discussion of the advantages of industrial electric furnaces from the points of view of both the consumer and the supplier of electrical energy. MS(23)

Heat-Treating Practice in Making Tractor Parts. *Iron Age*, Vol. 126, Sept. 4, 1930, pages 615–617.

Increased production, close temperature control and high quality of work have been effected at the plant of the Cleveland Tractor Co. by the use of a continuous electric furnace for heat treating. It is a chain belt conveyor type, built by the Electric Furnace Co. Furnace is used for hardening transmission gears, rollers, bushings and pins. The steels used are SAE 1020, a plain-C steel and SAE 3145, a Cr-Ni-Mo steel. Gives a description of the furnace. VSP(23)

Applications of Electric Furnaces. *Electrical Times*, London, Vol. 76, Dec. 12, 1929, pages 1035–1037.

Considers electric furnaces for the ferrous industry, reheating, sheet annealing, wire annealing, annealing of steel castings, malleabilizing of Fe, tempering, carburizing, tool steel hardening and for the non-ferrous industry including heat treatment of brass, Cu, German silver, etc., and the manufacture of Al. The growth of demand for electric heat-treatment furnaces from 1926 to 1929 is shown in graphs. (23)

Industrial Electric Furnaces. *Electrical Review*, Vol. 107, Oct. 17, 1930, pages 649–651; Oct. 24, 1930, pages 705–707.

Descriptions of various British manufacturers' products now available. MS(23)

Ford Forges with Electric Heat. *Electrical World*, Vol. 96, Nov. 15, 1930, pages 902–905.

At present the electric furnaces are used for heating only comparatively small forgings, universal joint housings, front wheel spindles, steering gear spiders, ring gears on their ends and the like. The silicon-carbide rods have superseded the carbon-trough type for ordinary forging operations. The simplest type is merely a sheet-steel or cast-iron shell with insulation and firebrick lining. The resistor bars are spaced across the top of the interior and their terminals brought out through ports in the sides. A slot 2–4 in. in height, running lengthwise on one side, allows the work to be placed in the furnace. Features are illustrated. WHB(23)

Fuel Economy at Skinningrove. FRANK BAINBRIDGE. *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1130–1134; Aug. 1930, pages 1293–1296.

Paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 744. MS(23)

Heat Treating Furnaces Become Production Machines. ROBERT M. COMSTOCK. *Iron Age*, Vol. 126, Sept. 11, 1930, pages 683–685, 722.

Continuous furnace is being applied to a wide variety of operations in production heat treating. Improved heat-resisting alloys have accelerated its development. Continuous annealing of metal strips is commanding widespread interest. Importance of atmospheric control in heating for heat treating in oil, gas and electric furnaces. Problem in heat treatment is quality production at low over-all cost of finished product. VSP(23)

Electric Furnaces. VERDON O. CUTTS (General Electric Co., Ltd., London). *Electrical Review*, Vol. 107, Oct. 17, 1930, pages 617–619.

Considers resistance-type furnaces and their various industrial applications. Most important advantage is the ease with which temperatures can be controlled. The present tendency is toward continuous-type furnaces. Among recent developments are the adoption of electric furnaces for bright annealing, vitreous enameling, hardening of high-speed steel, treatment of austenitic steels and melting of refractory metals. Such progress has been made possible by appreciation of the fact that, for many purposes, the electric furnace can compete with fuel-fired furnaces on a straight cost basis. Electric heating is an important factor in smoke abatement. MS(23)

Combustion of Blast Furnace Gas. T. J. ESS (Republic Steel Corp.). *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1613–1618.

Deals with formation of gas in the blast furnace, its characteristics, quantity produced under different furnace conditions, uses, cleaning, use of heat interchanges and combustion. Includes charts. MS(23)

The Homo Furnace for Nitriding Steel. (Nitrierhärtung von Sonderstahl mittels des Homo-Ofens.) A. FRY. *Stahl und Eisen*, Vol. 51, Jan. 1, 1931, page 19.

The Homo nitriding furnace is briefly described and the uniformity of parts nitrided in this furnace is pointed out. The furnace is most desirable for nitriding fine mechanical parts such as gages, calipers, etc. GN(23)

Investigations and Proposals on the Regulation of Rolling Mill Furnaces. (Untersuchungen und Vorschläge zur Einregelung von Walzwerksöfen.) F. WESEMANN. *Stahl und Eisen*, Vol. 50, Nov. 13, 1930, pages 1601–1610.

Report No. 144 of the Heat Committee of the Verein deutscher Eisenhüttenleute. The article summarizes the results of an investigation of a rolling mill furnace heated with semi-gas. Proposals are made to improve the heat efficiency of the furnace. GN(23)

Bringing the Furnace to the Work. J. C. WOODSON (Westinghouse Electric & Mfg. Co.). *Electric Light & Power*, Sept. 1930, Sec. 2, pages 140, 145–146, 148.

Outline of the development of electric heat-treating furnaces and description of several types. MS(23)

Open Hearth Furnace, System Terni. (Siemens-Martin-Ofen, Bauart Terni.) F. H. SCHÖNWÄLDER. *Stahl und Eisen*, Vol. 50, Dec. 11, 1930, pages 1749–1750.

The new furnace type is claimed to have a higher ton/hr. output due to the construction of the ports which permit working with a short and hot flame during the melting down period of the charge, but with a long flame during the working period and the boil. Since the air is furnished by a fan, the velocity of the flames and the conditions of combustion can be regulated. The Terni Steel Works, Italy, reported the following results:

	Total production/campaign in tons	No. of heats
20 ton furnace, old type	8,500	450
20 ton furnace, new type	24,000	1000
40 ton furnace, old type	16,000	450
40 ton furnace, new type	45,000	1000

The fuel consumption amounts to 20%, and under, of the weight of the cold charge. The time on a heat varies between 4 and 5 hrs. on a 35 ton heat. Data are given on the consumption of refractories. GN(23)

REFRACTORIES & FURNACE MATERIALS (24)

Cold Crushing Strength of Fire Brick. H. K. MITRA. *American Ceramic Society Journal*, Vol. 13, Feb. 1930, pages 85–87.

The purpose of this investigation was to determine the cold crushing strength of fire brick in 3 directions: flat, edge and endwise. The possible mathematical relationship between the values of these crushing strengths and the best procedure for testing fire brick are considered. (24)

Lining and Relining Furnaces. JOSEPH P. MCGINNISS. *Metal Industry*, N. Y., Vol. 28, Aug. 1930, pages 372–373.

Includes comments by H. E. White Vice-Pres., Lava Crucible Co. of Pittsburgh. Gives practical methods to save time and expense. VSP(24)

Sillimanite Bricks for Construction Material of the Roofs of Electric Furnaces. (Sillimanitsteine als Gewölbebaustoff für Elektrostahlöfen.) F. SOMMER. *Stahl und Eisen*, Vol. 50, Nov. 27, 1930, pages 1676–1677.

Whereas previous investigations on the application of sillimanite bricks for electric furnaces showed failures due to the cracking of the bricks, the use seems to be more promising now since burned sillimanite bricks are manufactured. Practical results with burned sillimanite bricks are given which show that the bricks have about 2.3 times longer life than silica bricks. GN(24)

Investigation of the Slagging of Refractory Materials. Part III. The Slagging of Magnesite. (Untersuchungen über die Verschlackung feuerfester Stoffe. Teil III. Die Verschlackung von Magnesit.) R. MICKSCH & H. SALMANG. *Archiv für Eisenhüttenwesen*, Vol. 3, Oct. 1929, pages 313–318; *Stahl und Eisen*, Vol. 49, Nov. 28, 1929, pages 1724–1725.

In order to test the slagging properties of magnesite, slags of various composition were melted in crucibles of magnesite. 2 kinds of magnesite were used; the one containing 85.46% MgO and 8.36% Fe_2O_3, the other containing 88.61% MgO and 4.48% Fe_2O_3. Temperatures of 1550° and 1650° C. were used in the tests. In general, free basic oxides do not attack magnesite but phosphoric acid and boric acid do attack it. Lime has a more destructive effect than iron oxide, MgO and alkalies. Magnesite containing a larger amount of fluxing agents is more readily attacked than that with a lower amount. GN(24)

Progress in the Field of Refractory Materials. (Fortschritte auf dem Gebiete der feuerfesten Baustoffe Halbjahrsübersicht, Apr.-Sept. 1929.) E. H. SCHULZ, F. HARTMANN & A. KANZ. *Stahl und Eisen*, Vol. 50, Nov. 27, 1930, pages 1677–1681.

80 references are reviewed, covering (1) raw materials, properties, preparation and production methods, (2) furnace construction and operation, (3) testing methods and equipment, (4) properties, (5) quality specifications, (6) special bricks and new refractories, (7) cements and molding sands, (8) survey of literature. GN(24)

Refractory Brick and Its Manufacture. H. E. TOWNSEND (Hiram Swank's Sons, Inc.). *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 105, 195–196.

Elementary account. MS(24)

Use of Refractory-Maintenance Cements in the Non-ferrous Foundry. H. E. WHITE. *Fuels & Furnaces*, Vol. 8, June 1930, pages 851–852.

From paper read before American Foundrymen's Association, Mar 12–16, 1930. MS(24)

Higher Temperatures Create Need for Superior Refractories. *Iron Trade Review*, Vol. 86, Jan. 2, 1930, pages 31, 121.

Developments during 1929 as seen by several authorities. MS(24)

Investigations on the Slagging of Refractory Materials. Part IV. Investigations on the Corrosion and the Constitution of Slags. (Untersuchungen über die Verschlackung feuerfester Stoffe. IV. Untersuchungen über die Korrosionkraft und die Konstitution der Eisenhüttenschlacken.) HERMANN SALMANG & FRIEDRICH SCHICK. *Archiv für Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 299–316; *Stahl und Eisen*, Vol. 50, Dec. 25, 1930, page 1814.

As in the previous investigations (*Archiv für Eisenhüttenwesen*, Vol. 2, 1929, pages 439–447 and Vol. 3, 1929–1930, pages 313–318), the slagging of refractories was studied by melting oxides, binary and ternary silicates and other groups of silicate melts in clay and sillimanite crucibles in the temperature range between 1410° and 1580° C. In all melts, CaO was the strongest base; FeO, MgO and MnO range next. FeO and MnO react as bases, whereas Fe_2O_3 and MnO_2 react as acids, i. e., they do not attack clay and retard the attack of the bases. It is remarkable that alkalis are not strong bases at high temperatures, as is true for low temperatures, because alkaline silicates do not, evidently, dissociate at high temperatures. P_2O_5, as an acid, hinders the attack of bases but readily attacks at higher temperatures when it is present in excess. The 2 formulae which follow hold for basic slags. (Composition in percent of weight; slagging, K, in mm. of dissolved crucible materials.)

$$1410°\ C.:\quad 1.25 \cdot \frac{7\,(CaO) + 7\,(MgO) + 5\,(FeO) + 4\,(MnO)}{(Al_2O_3) + 2\,(SiO_2) + (Fe_2O_3) + 5\,(P_2O_5)}\ \text{mm.}$$

$$1500°\ C.:\quad 1.8 \cdot \frac{7\,(CaO) + 4\,(MgO) + 4\,(FeO) + 3\,(MnO)}{(Al_2O_3) + 2(SiO_2) + 0.5\,(Fe_2O_3) + 2.5\,(P_2O_5) + (TiO_2)}\ \text{mm.}$$

GN(24)

GASES IN METALS (25)

Deoxidation of Copper with the Metallic Deoxidizers, Zinc, Beryllium, Barium, Strontium and Lithium. EARLE E. SCHUMACHER, W. C. ELLIS & JOHN F. ECKEL. *Metals & Alloys*, Vol. 1, Sept. 1930, pages 714–716.

Cathode sheet Cu was melted under charcoal in alundum-lined graphite crucibles heated in an electric resistance furnace, deoxidizers were added after the Cu had been removed from the furnace, the melt was stirred and then poured. In the case of the Cu deoxidized with Ba, Sr or Li, melts of 200 g. were prepared in fused SiO_2 crucibles. Whenever possible the deoxidizer was added as an additional alloy with Cu. Tests were made on wire of 0.104-inch diameter. Properties of Cu deoxidized with Zn: The ultimate strength remains nearly constant while the proportional limit decreases slightly with the increase in Zn content. The elongation in 2 inches increases from 4.5% for tough pitch Cu to 5.5% for the alloy containing 0.097% Zn and continues from this point to 0.377% Zn at an almost constant value. The alloys containing Zn were not embrittled by annealing in H_2 at 800° for one hour. The excess of Zn resulting from the deoxidation of Cu has a comparatively small effect on the conductivity of the Cu. Up to 0.3%, each 0.05% of Zn remaining reduces the conductivity approximately 0.8%. Properties of Cu deoxidized with Be: The ultimate strength increases slightly with the increase of Be content, while the % elongation decreases correspondingly. The alloys containing Be were not embrittled by the H_2 anneal. Each 0.05% of residual Be retained in the metal reduces the conductivity approximately 10%. Properties of Cu deoxidized with Ba and with Sr: In the case of both Ba and Sr only a small quantity of the added element remained in the Cu. The mechanical properties of the hard drawn and annealed wire are, in both cases, not much different from those of tough pitch Cu. The conductivities in the two conditions are generally high. The Cu has high ductility and strength after annealing in H_2. Properties of Cu deoxidized with Li: Li is exceedingly reactive with the oxides ordinarily present in refractories. Cu deoxidized with Li has good mechanical properties. Explanatory data and graphs are given to illustrate the effects of all of the added elements. ESC(25)

Manganese and Silicon as Deoxidizers. EDMUND R. THEWS. *Metal Industry*, London, Vol. 37, Aug. 1, 1930, pages 99–102.

Mn as a deoxidizing agent reacts similarly to P, except that the oxidation product of Mn forms a fluid slag which rises to the surface. On account of its high melting point, Mn cannot be used for deoxidizing purposes in its elementary state. Modern electric melting furnaces reduce production of Cu-Mn alloys to a mere matter of melting and mixing the components. Deoxidizing effects of Cu-Mn alloys exhibit a number of strongly individual features. The less Fe and C in Cu-Mn alloys the more pronounced their deoxidizing power, and the lower the loss by atmospheric oxidation. Compared with P, Mn exhibits a number of serious technical and economic disadvantages. The only distinct advantage of straight Cu-Mn alloys as deoxidizing agents is that small excess of Mn influences mechanical properties of a number of brass and bronze alloys. The deoxidizing action of Si on Cu and Cu alloys is similar to that of P. Its chief disadvantage is that of high melting and volatilization points. Cu-Si is mostly used as deoxidizer for Cu, bronzes and brasses. If added to straight Cu melts, best results are obtained with from 0.75 to 1.00%. Mechanical properties of brass alloys are but little influenced by traces of Si, while if Si added is just sufficient to effect deoxidation, tensile strength and elongation of alloys are improved. Includes several tables. VSP(25)

INSPECTION (26)

Spark Test Determines Metal Characteristics. *Abrasive Industry*, Vol. 11, May 1930, page 29.

Explains the relation of the study of color, form, quantity and nature of sparks to quick information on the kind of metal being ground. (26)

EFFECT OF ELEMENTS ON METALS & ALLOYS (27)

Molybdenum in Steel Industry. *American Metal Market*, Vol. 38, Jan. 9, 1931, pages 8, 9.

One of the features of 1930 in metallurgy was the greater use of molybdenum as an alloying material. Chrome-molybdenum alloy steel is regarded as essential for tubing out of which fuselage for airplanes are fabricated. All nitriding steels contain molybdenum. Nickel-molybdenum steels are used in the roller bearing industry. Plain molybdenum steels are used for some special alloy steel shovels and other uses. Molybdenum is being introduced in the 18% chromium-8% nickel types of steels to the extent of 1–3%, particularly where strength at high temperatures is needed. A special alloy of nickel, molybdenum and iron is unattacked by hydrochloric acid and is being produced as castings and as rolled products, which should find extensive use in the hydrochloric acid industry. WHB(27)

Twenty Alloys for Gray Iron. E. K. SMITH & H. C. AUFDERHAAR. *Iron Age*, Vol. 126, Nov. 27, 1930, pages 1583–1587; Dec. 4, 1930, pages 1688–1693.

Chiefly a discussion of literature published on the subject. In several instances investigations are now under way, and results are not yet available. Al has 3 valuable possibilities in the foundry: (1) addition of not more than 0.10% as softener and deoxidizer; (2) addition up to 0.5% to turn white Fe gray; (3) as corrosion resisting alloy of austenitic type with about 18% Al. Very little information available on the effect of Sb in cast Fe. As up to 0.1% has no deleterious effect. Investigations in progress now indicate that Bi may be used to advantage in some types of cast Fe. B increases hardness and makes metal brittle, preventing formation of graphite. Ca up to 0.2% has no effect on tensile strength, transverse strength, fluidity or shrinkage. Data on Ce in cast Fe is very meager. Use of Cr has many advantages by reason of its low cost and finds many applications. Cr is usually connected with Ni. Up to 2% of Co no useful results have been obtained. Small amounts of Cu readily enter into solution in matrix of cast Fe. Cu confers corrosion resistance to cast Fe. Pb will not alloy with Fe. Little work has been published on Mg. Effect of Mn on cast Fe is fairly well understood. Mo acts as strengthener and hardener of gray Fe. In general Ni acts as a softener. It breaks up carbides, reduces chill and separates out graphitic C. When Si ranges above 5%, character of cast Fe changes and Si may be considered an alloy. Sn seems to have possibilities as a hardener under special circumstances. Action of Ti is that of a deoxidizer and possibly a remover of N. W retards the decomposition of carbides. V increases hardness transverse and tensile strength and resistance to impact. Owing to its rapid oxidation Zn cannot be found in Fe. No definite information is available on Zr. VSP(27)

The Impurities in Lead and Their Influence on the Lead Grain. (Ueber die Zwischensubstanz des Bleis und ihren Einfluss auf Bleikorn.) G. TAMMANN & K. L. DREYER. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 191, July 7, 1930, pages 65–68.

It is shown that the addition of 0.1% Cu to Pb in the molten state hinders the grain growth on cooling so that the resulting metal has smaller grains and, subsequently, a greater tensile strength. (27)

Influence of Aluminum on Technical Brass Alloys. EDMUND R. THEWS *Canadian Chemistry & Metallurgy*, Vol. 14, Nov. 1930, pages 322–323, 325.

Al represents one of the most useful addition agents when added in the correct proportions and under correct conditions. Alumina is responsible for the misgivings regarding the value of Al in brasses. Al tends: to produce the valuable properties of bronzes; to increase the tensile strength and density; increase resistance to corrosion; and, in small quantities in Zn-rich brass alloys, to create a freedom from Zn vapors. The production of Al-brass castings free from aluminum oxide must be viewed from 3 angles: (1) prevention of the introduction of excessive quantities of oxide in the melt. (2) removal of the oxide from the melt previous to casting and (3) casting in a manner preventing the introduction of aluminum-aluminum oxide skins into the castings. Cu should be deoxidized before the addition of Zn and Al. While the presence of aluminum oxide cannot be completely avoided in the bath, the addition of a small quantity of phosphor-copper directly previous to casting causes the oxide to float and they are easily removed. Bottom-pouring tends to minimize agitation of the bath and the introduction of dross. To secure high-grade Al-brass castings, it is necessary to keep Al-brass out of the brass scrap charged. A brief bibliography is appended. WHB(27)

Investigation of the Effects of Impurities on Copper. Part VII.—The Effect of Antimony on Copper. Part VIII.—The Combined Effect of Antimony and Arsenic on Copper. S. L. ARCHBUTT & W. E. PRYTHERCH (National Physical Laboratory). *Institute of Metals, Advance Copy* No. 546, 1931, 33 pages.

Alloys containing less than 0.02% O were investigated. Those containing up to 0.47% Sb rolled hot, while one with 0.85% Sb was hot short. Annealed ingots containing up to 0.85% Sb could be cold rolled. All alloys containing 0.47% or less Sb could be rolled into thin sheet. Sb increases strength without appreciably affecting ductility. The endurance limit of the annealed 0.47 Sb alloy was 7.8 tons/in.^{2} as compared with 5 or 6 tons/in.^{2} for pure Cu. The softening temperature is raised by Sb, its effect being greater than that of As. The limit of solubility of Sb in solid Cu was determined microscopically as approximately 10%. The addition of As to alloys containing Sb had only slight effect on the properties. All of the alloys had high impact strengths. Contains 9 references. JLG(27)

The Effects of Nickel upon the Mechanical Properties and Micro-Structure of White Heart Malleable Cast Iron. J. V. MURRAY. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 45, 1929–30, pages 40–44.

Specimens of cupola malleable with additions of nickel shot in the ladle were cast in green sand and annealed 6 days, excluding heating up and cooling down. The annealing temperature is not stated. Another series made up in the cupola was similarly treated. Carbon analyses were not given. The data follow:

	Composition					Mechanical Properties		
	Si	*S*	*P*	*Mn*	*Ni*	Tensile Strength lbs./in.²	Elongation % in.2″	Bend Test on 8″ × 1″ × 3/8″ degrees
	–		–	–	—	45,000*	5*	45*
Cupola	43	.14	.11	.14	Nil	48,000	6.5	67
	59	.18	.08	.12	.51	48,500	5.0	46
	45	.12	.07	.11	.78	50,500	4.2	43
	52	.18	.07	.05	1.02	57,000	4.5	33
	56	.18	.08	.12	1.53	50,500	3.5	33
	73	.18	.09	.14	2.59	56,500	3.5	24
	80	.18	.07	.14	3.06	49,000	2.5	16
	78	.16	.08	.15	3.42	38,500	1.8	2
	77	.19	.07	.14	3.53	30,500	1.2	0
Crucible	64	.18	.07	.18	.27	60,000	4.0	81
	54	.18	.05	.16	.55	54,000	4.3	60
	55	.12	.06	.20	.74	57,000	4.2	35
	74	.09	.06	.22	.98	57,000	9.3	53
	68	.16	.07	.20	1.33	45,500	2.3	23
	66	.14	.06	.19	1.76	61,000	4.2	27
	66	.16	.10	.17	2.59	63,500	3.2	52
	68	.11	.09	.23	2.71	61,000	5.2	37
	56	.15	.07	.14	3.06	61,500	3.0	54

* British Eng. Stds. Assn. Specification No. 309—Tensile bar 0.564″ diam.

It is concluded that nothing is gained by raising the nickel above 1%; this addition increases the tensile strength to 57,000 lbs./in.², though in the cupola series the elongation and bend were dropped below specification limits. With 1% Ni the usual totally decarburized outside zone is absent, pearlite being present clear to the edge. Nickel retards the breakdown of pearlite during annealing. With over 1% Ni the pearlite becomes troostitic, while with 3%, graphite flakes appear, and the pearlite is again of normal structure. HWG(27)

Use of Bismuth in Fusible Alloys. J. G. THOMPSON. *U. S. Bureau of Standards Circular* No. 388, December 15, 1930, 8 pages, 45 references. Supt. of Documents. 5 cents.

Discussion of composition, melting point and uses of low-melting alloys of Pb, Si, Bi and Cd. The quaternary eutectic is at 70° C. and figures in the literature indicating lower melting points for these alloys (free from Hg) are in error. HWG(27)

Nickel Cast Iron in Theory and Practice. (Nickelgusseisen in Theorie und Praxis.) M. WAEHLERT. *Giesserei*, Vol. 17, Jan. 17, 1930, pages 57–63.

Efforts which have been made to improve cast Fe are discussed. Consideration of the influence of alloy additions; Ni and Ni-Cr; reciprocal effects of these and Si, P and S; raw materials and alloying processes; applications and initial costs. (27)

The Effect of Additions of Small Percentages of Nickel to a Copper-Tin Bronze. C. UPTHEGROVE, G. WILSON & F. N. RHINES (Univ. of Mich.). *Proceedings American Society for Testing Materials*, Vol. 30 Part 2, 1930, pages 512–521.

Includes discussion. Hardness (Rockwell and micro character) and microstructure, but no other properties, were determined on alloys containing 15% Sn, the 85% Cu being partly replaced by 0, 1/4, 1/2, 1, 2, 3, 5 and 10% Ni in chill cast alloys and 0, 1, 2, 3 and 5% in sand cast alloys. The specimens were annealed for 120 hrs. at 800° C. and furnace cooled. The Rockwell hardness rose from around 40 for zero, 1/4 and 1/2% Ni up to about 75 for 3% Ni and then fell to about 60 for 10% Ni. The corresponding changes in the α and δ constituents were followed by the micro character. The micro character indicated that the hardness of both constituents rose to a maximum at 5% Ni, that of the α rising steadily, while that of the δ first fell to 1/2% Ni, and then rose steadily to 5% Ni. Substitution of Ni for Cu leads to the disappearance of α from the eutectoid and the appearance of a dispersed constituent throughout the α-matrix. This dispersion accounts for the increased hardness of the α. (27)

INSTRUMENTS & CONTROLLERS (28)

The Equipment of Heat Control of the Open Hearth Furnaces of the Rasselstein Steel Plant. (Die Wärmetechnische Messanlage an den Siemens-Martin-Oefen der Rasselsteiner Eisenwerke.) K. H. MOLL. *Siemens Zeitschrift*, Vol. 10, Dec. 1930, pages 615–620.

An illustrated description of all instruments for supervising the heat efficiency of the Rasselstein open-hearth plant. All recording instruments are installed in a special supervision room. GN(28)

Color Pyrometry. (Zur Farbpyrometrie.) G. NAESER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 163, pages 299–316; *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, pages 1788–1789.

This is the last installment of Naeser's papers on the color pyrometer. After reviewing the various methods which can be used in measuring temperatures by means of measuring the color of emitters, 2 of these methods were carefully examined. The first method, as previously described (*Stahl und Eisen*, Vol. 49, 1929, pages 464–466), is based on the comparison of colors; the other measures the brightness of the colors. Both methods are described and the suitability investigated and established. Color pyrometer offers large advantages. See also *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. GN(28)

The Influence of Atmosphere, Temperature and Material of Protection Tubes on the Stability of Platinum Thermo-couples. (Ueber den Einfluss von Glühatmosphare, Glühtemperatur und Schutzmaterial auf die Beständigkeit von Platinelementen.) F. STÄBLEIN & H. HINNÜBER. *Krupp'sche Monatshefte*, Vol. 11, Sept.–Oct. 1930, 245–251.

This paper corresponds to the publication in *Archiv für Eisenhüttenwesen*, Vol. 3, June 1930, pages 781–785 and in *Stahl und Eisen*, Vol. 50, July 31, 1931, pages 1089–1090. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789. GN(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

Investigations of the Mechanical Strength of Steels and Alloys at High Temperatures. (Etudes sur la Résistance mécanique à chaud des Aciers et Alliages.) A. MICHEL (Etablissements Jacob Holtzer, France). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 85–88.

Very brief reference to French publications in this field. The "limit of sudden elongation without flow" at 450° C. of a steel of about 0.30% C, 0.75% Cr, 2.75% Ni is raised from 27,000 to 38,500 or 52,500 lbs./in.² (depending on heat-treatment) by the addition of 0.33% Mo. HWG(29)

The Effect of Temperature upon the Torsional Modulus of Spring Materials. F. P. ZIMMERLI, W. P. WOOD & G. D. WILSON. *Proceedings American Society for Testing Materials*, Vol. 30, Pt. 2, 1930, pages 350–367.

Includes discussion. See *Metals & Alloys*, Vol. 1, Oct., 1930 page 789. (29)

Factors Affecting the Chilling Properties of Cast Iron. A. L. NORBURY. *Foundry Trade Journal*, Vol. 43, July 17, 1930, pages 44–45.

From a paper presented to the Pan-European Foundry Congress, Liege, June 1930, on behalf of the Institute of British Foundrymen. Chilling properties of cast Fe are largely dependent on its chemical analysis, particularly Si content. But it has been realized that other qualities affect chilling of Fe. Valuable work has been done by Piwowarsky, Hanemann, Bardenheuer and others. Gives results of differences in chilling properties obtained from Fe of same chemical analysis and also results of the effect of total C, Si, Mn and S contents, and mold temperature on chilling properties. VSP(29)

Long Heating Periods at High Temperatures Affect Gray Cast Iron. R. S. MACPHERRAN & H. KRUEGER. *Foundry*, Vol. 58, Oct. 1, 1930, pages 103–106, 111–112.

Cites tests conducted by various investigators. These tests were carried out at temperatures in excess of 1100 or below 850° F. The authors determined the effect of heat on various types of gray cast Fe from 800° to 1100° F., showing changes in combined C, Brinell hardness, tensile and transverse strength. One series was heated to various temperatures for 500 hours intermittently, while the other was heated continuously. Tests showed low tensile strength at elevated temperatures. Best results were obtained from a series containing Cr. Outlines European practice. Tabulates results of investigations. VSP(29)

Hardness of Metallic Alloys at Various Temperatures. (Die Härte der Metallegierungen bei verschiedenen Temperaturen.) V. P. SHISHOKIN & V. AGEJEWA. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 193, Oct. 21, 1930, pages 237–244.

Hardness determinations were made on binary alloys in which the components do not form chemical compounds: Bi-Sn, Bi-Cd, Pb-Cd, Sn-Cd, Pb-Sn, Sn-Zn, Zn-Cd. In all cases except Pb-Sn, hardness composition curves show a similar course for all systems at all temperatures. Deviations in the case of Pb-Sn alloys are, perhaps, explained by insufficient heat treatment. Breaks in the curves at 2.7% Bi in the Cd–Bi system, at 8.7% and 38% Cd in Cd–Pb, and at 1.7%, 2.9% and 90.9% Pb in Pb–Sn are probably due to the passing of the 2 components into solid solution. In the Cd–Zn, Sn–Zn, and Cd–Sn systems, these breaks are due to eutectoid transformations. The temperature coefficient of hardness of the investigated alloys is greater than the temperature coefficient of the pure metals, and is given by the expression: $\alpha = \frac{\log H_2 - \log H_1}{t_2 - t_1}$. The greatest increase in α is in the alloy Bi-Sn (0.0028 – 0.0017), the smallest in the alloy Pb-Cd (0.0039 – 0.0057) and Zn-Sn (0.0038 –0.0056). Solid solutions of low concentrations are found on both sides in the system Bi–Sn but only on the Pb side in the system Pb–Cd; no solid solutions are found in Zn–Sn. In all the systems except Sn–Cd the highest temperature coefficient of hardness is found in the region of the eutectic. The displacement of the maximum in the Sn–Cd system is probably explained by the presence of a eutectoid point. The magnitude of the temperature coefficient of hardness is apparently not influenced by annealing conditions. (29)

Behavior of Metals at High Temperatures. (Verhalten von metallischen Werkstoffen bei hohen Temperaturen.) H. STÄGER (Switzerland). *First Communications of the New International Association for the Testing of Materials*. Group A. Zurich, 1930, pages 89–96.

Short-time tests and long-time flow tests are given on 15 steels at 400°, 500° and 600° C. Steels containing Mo were superior at the higher temperatures to comparable Cr and Ni Cr steels.

Composition			Creep Limit, lbs./in.²	
C	Mo	Cr	500° C.	600° C.
.25	.41	—	9000	2100
.22	.80	—	10000	2800
.64	1.83	16.0	57000	5500

HWG(29)

The Magnetic Properties of Metals at Low Temperatures. (Die Magnetischen Eigenschaften der Metalle bei tiefen Temperaturen.) H. R. WOLTJER. *Metallwirtschaft*, Vol. 8, Nov. 1, 1929, pages 1060–1061.

Contains 15 references. A review of the work of other investigators on paramagnetic, diamagnetic and ferromagnetic metals at temperatures as low as −253° C. CEM(29)

LEACHING (30)

Chemistry of Leaching Bornite. JOHN D. SULLIVAN. *Bureau of Mines Technical Paper* 486, 1931, 20 pages.

Bornite can be leached with ferric sulphate. The rate of dissolution was virtually independent of the strength of the ferric sulphate if enough reagent was present. As ferric salts reduce current efficiency and necessitate higher current densities in electrolytic precipitation it is desirable to keep their concentration as low as possible. If the ferric iron remained constant, the rate of dissolution was independent of acid strength (0.25 to 10%). The rate for 10 to 28 mesh particles was practically identical with that for 100 to 200 mesh mineral. Smaller material was attacked only slightly more rapidly and larger only slightly more slowly. Temperature had a marked effect. Leached particles retained practically their original form. The final particles were composed of sulphur and insoluble material. Sulphuric acid and air will attack bornite more slowly than ferric sulphate. Ferric chloride was more effective than ferric sulphate. AHE(30)

REDUCTION METALLURGY (31)

The Oxidation of Copper during Smelting and the Importance of Oxide Test. (Zur Oxydation des Kupfers bei Flammofenraffination und die Bedeutung der Oxydprobe.) P. SIEBE. *Metall und Erz*, Vol. 27, Nov. 1930, pages 549–557.

Contains 3 references. The nature and amount of impurities in Cu during the oxidation stage of smelting can be determined quickly by microscopic examination. Tests made on samples from smelters and laboratory melts are described. During the oxidation and at the beginning of the reduction period: 1. Long dendrites in the eutectic ground mass indicate high purity of the melt; if round Cu_2O inclusions are present they are always without core. 2. Short dendrites and round Cu_2O inclusions with cores indicate impure melt; the dendrites are shortened by higher Sn content and Sb, As and Pb impurities. 3. As the oxidation progresses the length of the dendrites increases, more in the pure than the impure melts; a coarse fracture indicates long dendrites. 4. The poling process is shown by the appearance of ring shaped Cu_2O inclusions. In hypereutectic test heats: 1. Small amounts of Ni and Sn do not change the structure, but Sb and As tend to ball up the eutectic and shorten the dendrites. 2. Overheating the melt causes the formation of longer dendrites; quicker cooling does not influence the arrangement of the dendrites, but causes finer eutectic separations. 3. Brinell hardness increases with increasing fineness of eutectic. CEM(31)

The Loss of Air Pressure in the Bustle Pipes of the Blast Furnace. (Druckverluste in Hochofenwind-Leitungen.) MARCEL STEFFES. *Stahl und Eisen*, Vol. 50, Nov. 20, 1930, pages 1644–1645; *Revue Technique, Luxembourgeoise*, Vol. 22, Sept–Oct. 1930, pages 99–102.

After determining the loss of air pressure in the bustle pipe of the blast furnace investigated, the hot air pipe of this furnace was completely reconstructed, the inner diameter was increased from 800 to 1000 mm., sharp bends were avoided or at least diminished. The totol loss of pressure, which amounted previously to 15 cm. Hg, was reduced to 6 cm. Hg. A further improvement was accomplished by changing the type of tuyères. A pressure of 1 cm. Hg is equivalent to 35 HP. on the blowers. GN+Ha(31)

Calculation of a Copper Puddling Charge. (Berechnung einer Kupfer-Flammofenbeschickung.) VICTOR TAFEL. *Metall und Erz*, Vol. 27, Jan. 1930, pages 10–11.

An example is given of a simplified method of calculating the quantities of ore and flux required, and the resulting quantity and composition of Cu, blister Cu and slag in a 1000 kg. charge. CEM(31)

Metallurgy in 1929. (Das Metallhüttenwesen im Jahre 1929.) V. TAFEL. *Metall und Erz*, Vol. 27, June 1930, pages 309–316.

Contains 20 references. A review of the literature concerning the progress in the smelting, production and metallurgy of non-ferrous metals during 1929. CEM(31)

Reduction of Metal Oxides by Hydrogen. GUY B. TAYLOR & HOWARD W. STARKWEATHER. *Journal American Chemical Society*, Vol. 52, June 1930, pages 2314–2325.

A new method for studying the rate of reduction of metal oxides at temperatures below 500° C. is described. In this, the volume of H is measured. Ferric oxide gel is reduced to ferroso-ferric oxide at 350 and to metallic Fe at 450°. Ignited ferric oxide is not reduced at an appreciable rate at 350° and goes to metal at 450°. Foreign metal interfaces with iron oxide accelerate the reduction to Fe. Alumina and chromium oxide greatly retard reduction of ferroso-ferric oxide. Ferric oxide gels show the flow phenomenon in H at fairly low temperatures, but not in air or in vacuum. The thermodynamics of ZnO reduction in the presence of Cu has been worked out, giving an explanation in the formation of α-brass. MEH(31)

The Reactions in the Hearth of the Blast Furnace. (Die Vorgänge im Unterofen des Hochofens.) A. WAGNER. *Stahl und Eisen*, Vol. 50, Jan. 30, 1930, pages 122–126. 6 references.

After reviewing the literature on the reactions in the lower part of a blast furnace, the reasons are discussed which lead to a low output of Mn and P in many blast furnaces working on Minette ore. Whereas the amount of indirect reduction in the hearth of the furnace is rather limited and determined by the nature of the charge and the kind of pig iron to be produced, it is quite possible to alter the conditions of combustion in front of the tuyères by installing tuyères which have the shape of a double cone. By using the so-called Venturi-tuyères, an essential increase of output was observed. The Venturi form permits a greater conversion of the velocity of the blast into pressure so that a furnace will take about 15% more volume of blast without the necessity of increasing the blast pressure. The daily output of a blast furnace increased from 891 to 963 tons after the installation of the Venturi-tuyères. GN(31)

Investigations of a Blast Furnace Working on Minette Ore and Using Saar Coke. (Untersuchung eines mit Saarkoks betriebenen Minett-Hochofens.) A. WAGNER & G. BULLE. *Archiv für Eisenhüttenwesen*, Vol. 3, Dec. 1929, pages 391–395; *Stahl und Eisen*, Vol. 49, Dec. 26, 1929, pages 1860–1861.

The authors give the results of an investigation of the reduction process of the ore during its descent through the blast furnace, the conditions of the combustion of coke and the calculation of a heat balance. Gas samples were taken in the shaft in 3 levels: 6.15 m., 9.4 m. and 12.2 m. above the zone of the tuyères. The discrepancies of the individual gas analyses, however, are too great to allow drawing reliable conclusions on indirect reduction and C segregation. The only reliable conclusion is that, in the lower zones of the furnace, very large qauntities of CO and H must be present. This is probably due to the quick descent of large lumps of ore which do not become thoroughly roasted unless they reach the lower parts of the shaft. Only about $8^1/_2$% of the coke is used for the reduction of the ore to Fe, but approximately 4% for the decomposition of the moisture. About 81% of the coke reaches the zone of the tuyères unburnt. Information is given on the composition of samples of the charge drawn from the shaft as well as on the composition of slag. Temperatures observed in the furnace vary widely. GN(31)

Electrothermic Zinc. A. WALTER. *American Electrochemical Society, Preprint* 59–4, April 1931 Meeting, 4 pages.

The development of electrothermic zinc during the past 30 years is briefly reviewed, emphasizing in particular the many difficulties to be overcome before the process became commercial. The smelting is carried out in an arc furnace of the Heroult type. The operation is continuous and comparatively simple. The zinc vapors pass out of the furnace and into a condenser, from which the zinc is tapped at regular intervals. The crude zinc (93–95% Zn) thus produced is refined by resublimation in a separate electric furnace. The final product averages 99.85% Zn. The process outlined is applicable to all kinds of zinc ores, and high recoveries of accompanying metals such as Cu, Pb, Au and Ag are possible. The total electric energy consumption amounts to 5600 kwh./1000 kg. of 99.85% slab zinc. (31)

Iron Ores Beneficated by Direct Reduction and Concentration. GEORGE B. WATERHOUSE. *Iron Age*, Vol. 127, Jan. 8, 1931, pages 161–162.

Presents some of the results obtained by W. H. Smith on the benefication of low content Fe ores by the sponge iron process, thus to render them equal to high grade ores. The process consists in low temperature reduction of the ore, followed by crushing and magnetic concentration. Concentration will remove from 20 to 90% of the gangue. Gives table showing results obtained on various ores from U. S. and foreign countries. VSP(31)

Notes on the History of Furnace Linings. E. G. WHELPLEY (Shea-Whelpley Construction Co.). *Blast Furnace & Steel Plant*, Vol. 18, Feb. 1930, pages 288–290.

Deals with the development of linings for blast-furnaces, and discusses the place of the furnace building contractor in relation to present plant conditions. MS(31)

Recovery of Zinc from Ferrite Compounds in the Electrolytic Zinc Process. G. L. OLDRIGHT & D. P. NICONOFF. Department of Mining and Metallurgical Research, University of Utah, *Technical Paper* 6, 1929, 45 pages.

Zinc ferrite formation increased with increasing time, temperature and fineness. Iron in zinc ferrite was more readily soluble than when present in Fe_2O_3. Replacement of ZnO in ferrite by other bases such as CaO and MgO is possible, but not practical. Zinc ferrite was readily decomposed by treatment with reducing agents at elevated temperatures; zinc was then soluble in ammonia or sulphuric acid. High concentrations of reducing gases make the iron soluble in sulphuric acid. Carbon will reduce ferrites at 800°. Pure CO should not be used below 600° as CO_2 is needed at low temperatures to prevent its decomposition to CO_2 and C. The best procedure was treatment for 2 hours at 550° with CO_2 containing 35–50% CO. This makes 80% of the zinc and 39% of the iron soluble in sulphuric acid. To make more zinc soluble, higher proportions of iron were dissolved. The rate of decomposition of ferrite with reducing agents, as well as its rate of dissolution in sulphuric acid, hydrochloric acid, and nitric acid depend upon the temperature and time of preparation of the ferrite. By giving refractory ferrite a preliminary low-temperature roast, the subsequent rate of reduction can be increased AHE(31)

Washing Mesabi Iron Ores. S. A. MAHON & T. B. COUNSELMAN. *Engineering & Mining Journal*, Vol. 130, Nov. 24, 1930, pages 519–521.

An abstract of a paper read at a recent meeting of the Lake Superior Mining Institute. Changes made over the original flowsheet of the mine involve: (1) the replacement of the turbos and tables with bowl classification, (2) the introduction of secondary crushing for further liberation of silica from the coarser sizes, and (3) the tendency toward the use of abrasive screening on much of the material formerly treated in the 25-ft. log washers. Several tables, and flowsheets for the original process, for bowl classification and secondary crushing and with the Dorr washer are shown. WHB(31)

Disintegration of Blast Furnace Slag. (Ueber den Zerfall der Hochofenschlacke). F. HARTMANN & A. LANGE. *Archiv für Eisenhüttenwesen*, Vol. 3, April 1930, pages 615–624; *Stahl und Eisen*, Vol. 50, April 17, 1930, pages 517–518.

Following a survey of the literature on the subject, the authors give the results of their own experiments to determine the influence of composition and heat treatment on the composition of slag. See also *Metals & Alloys*, Vol. 2, Feb. 1931, pages 51. GN(31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Use of Burn-Off Ovens in Preparing Metal Surfaces for Baked Finishes. WILLIAM J. MISKELLA. *Fuels & Furnaces*, Vol. 8, April 1930, pages 531–536.

Burn-off process for removing oil and grease is used for large articles and where there are seams and folds. Automotive parts are usually subjected to a temperature of 600°–700° F. for 3 or 4 min., and are wiped while hot. For removing paint and varnish, the temperature is about 700° F. Other methods of cleaning metal parts are by the use of alkaline solutions, acid dips, and organic solvents. Gives examples of various cleaning operations. MS(32)

Applying Baked Color Finishes to Metal Surfaces. WILLIAM J. MISKELLA. *Iron Trade Review*, Vol. 86, April 3, 1930, pages 71–74.

Describes methods used in japanning and enameling. The finishes are applied by dipping or spraying and are dried in ovens, the time varying from 15 min. to 4 hrs. Elaborate handling systems have been installed in many plants, making the process almost completely automatic. MS(32)

Vitreous Enameling Cast Iron. C. D. CLAWSON (Chicago Vitreous Enamel Product Co.). *American Machinist*, Vol. 72, Oct. 9, 1930, pages 579–581.

Deals largely with the application of enamel by the dry and the wet process. Some material on the finishing and cleaning of the cast iron. RHP(32)

Enameling Industry Solves Problem of Continuous Burning. *Iron Trade Review*, Vol. 86, Jan. 2, 1930, page 30.

Several authorities give views on progress made during 1929 in pickling and enameling. MS(32)

Recirculating and Remote Heater Type Ovens. WILLIAM J. MISKELLA (Finishing Research Laboratories, Inc.). *Fuels & Furnaces*, Vol. 8, Feb. 1930, pages 255–256, 262.

Relates to japanning ovens. Discusses construction and operating features. MS(32)

Development in the Use of Ovens for Baked Finishes. WILLIAM J. MISKELLA. *Fuels & Furnaces*, Vol. 8, June 1930, pages 821–822.

New synthetic undercoat for application under lacquer finishes is sprayed on and dries in 15 min. Surfacer is then applied and both are baked at once. A baking process has been developed, wherein 2 coats of japan, or any other finishing material, are applied in such a way as to require only one bake. MS(32)

Japanning Oven Construction. WILLIAM J. MISKELLA. *Fuels & Furnaces*, Vol. 8, May 1930, pages 679–682.

Discusses some important features such as selection of heating medium, insulation, door construction, ventilation, roof, load supports, and corner design. MS(32)

Use of Automatic Spray Equipment. WILLIAM J. MISKELLA (Finishing Research Laboratories, Inc.). *Metal Cleaning & Finishing*, Vol. 2, April 1930, pages 335–338. Discusses applications, uses, and advantages of automatic spray equipment for finishing metal parts. MS(32)

Selection of Japanning Ovens. WILLIAM J. MISKELLA. *Fuels & Furnaces*, Vol. 8, Jan. 1930, pages 115–118.

Discussion of the advisability of systematic planning. MS(32)

Tumbling and Flowing Methods of Applying Finishing Materials. WILLIAM J. MISKELLA (Finishing Research Laboratories, Inc.). *Metal Cleaning & Finishing*, Vol. 2, Feb. 1930, pages 145–148, 160.

Traces development of the tumbling and flowing methods and points out advantages of each. Tumbling is used mostly for small objects. It is a very simple method, and has the great advantage, when the tilted barrel is used, of allowing samples to be easily examined without stopping the barrel. The flowing method is about cleanest method of applying finishes. MS(32)

Important Features Regarding the Installation and Operation of Japanning Ovens. WILLIAM J. MISKELLA. *Fuels & Furnaces*, Vol. 8, March 1930, pages 375–378.

Discussion of location of japanning ovens, and their accessibility, safety of operation, ventilation, heating systems, and cleaning. Based on a report of a committee of engineers of the National Fire Protection Association, completed Jan. 16, 1930. MS(32)

Blistering Tendency of Some Cast Irons when Enameled. A. I. KRYNITSKY & W. N. HARRISON. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Aug. 1930, pages 332–372.

Blistering resulting from gas entrapped in the enamel may arise from sponginess of metal, from method of application of enamel and from a very thin surface skin or micro chill on the cast iron. The latter may break down during the process into temper carbon which oxidizes easily. Blistering may be overcome by making the chill either very stable or by removing it entirely with graphitizing agents. Practical remedies are to deep sand blast or to "burn out" the casting. See also *Metals & Alloys*, Vol. 1, Sept. 1930, page 742. CHL(32)

Finishes on the Metal Parts of Telephone Apparatus. H. G. ARLT. *Bell Laboratories Record*, Vol. 9, Dec. 1930, pages 175–179.

At the present time some hundred standard metal finishes are being used on telephone apparatus parts. This paper discusses them and their purposes. MFB(32)

Continuous Enameling Furnace Is Heated Electrically. J. D. KNOX. *Iron Trade Review*, Vol. 86, April 10, 1930, pages 65–67.

Describes equipment and operations of the Mullins Mfg. Co., Salem, Ohio, for vitreous enameling of washing machine tubs. MS(32)

Paint Failure Diagnosis. ROBERT JOB. *Metal Cleaning & Finishing*, Vol. 2, June 1930, page 527.

Abstract of paper read before the American Society for Testing Materials. MS(32)

Testing Lacquers in the Plating Shop R. V. KIRK. *Brass World*, Vol. 26, Nov. 1930, pages 296–297.

A suggestion to the plater who uses lacquer; means by which he may in a quick and empirical, yet practical way, test and evaluate the many lacquers offered for his use. Simple tests for showing the characteristic properties of lacquers are outlined. WHB(32)

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MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

601 **Electrical Resistance Measurements.**—Catalog No. 40 of the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., lists instruments intended specifically for measuring the resistance of electrical conductors, such as standard resistors, Wheatstone bridges, Kelvin bridges, etc. Some other closely related instruments are also listed.

602 **Nickel-Clad Steel.**—The Lukens Steel Co., Coatesville, Pa., has sent out a folder recently announcing their Nickel-Clad Steel Plate. In the hot rolling process the pure nickel is actually welded to the steel. The product is available in all sizes of plates $^{3}/_{16}$ inches thick and heavier, and in two grades in which the solid nickel is 10% or 20% of the thickness of the Nickel-Clad Steel Plate. The company has also prepared a reprint of an article "Nickel-Clad Steel Plate Work" which appeared in *Mining and Metallurgy*, Feb. 1931.

603 **Electric Furnaces.**—A recent publication of the Process Engineering & Equipment Corp., Attleboro, Mass., is a 12-page booklet describing several of their special atmosphere electric furnaces which keeps air from the material while it is being heat treated and cooled. The work is removed bright and clean and ready for succeeding operations or finishing.

604 **Stainless Alloy Steels.**—To the development and production of ferritic chromium-alloy steels and austenitic chromium-nickel steels, five of the subsidiary manufacturing companies of the U. S. Steel Corporation have applied the resources of their respective organizations and research departments. A booklet descriptive of the properties of the alloys will be sent by the American Sheet & Tin Plate Co., Frick Building, Pittsburgh, Pa.

605 **Speed Reducers.**—A leaflet has been prepared by Gears & Forgings, Inc., Cleveland, Ohio, which describes their planetary, worm gear, and herringbone speed reducers. For more detailed information on planetary speed reducers write for Bulletin B. Bulletin C is devoted to worm gear speed reducers.

606 **Sand Testing Equipment.**—One of the most attractive catalogs which has come to our desk recently is Catalog No. 102 of the Harry W. Dietert Co., 676 W. Grand Blvd., Detroit, Mich. Sieves to determine the fineness of sand are illustrated, as well as instruments to gage its strength, permeability and bonding value. The section containing practical and technical data should be very useful.

607 **Arc Welding of Structural Steel.**—The Westinghouse Company is a pioneer in the use of arc welding for the construction of buildings and bridges, having begun in 1926 with several small buildings at their plant in East Pittsburgh and a five-story building at Sharon, Pa. They have just published a most interesting and valuable booklet with the above title, which contains chapters on the strength of welded joints, the inspection of welds, and an outline for estimating the cost of welded construction. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

608 **Arc Welding Structural Steel.**—Another interesting booklet on this subject is gotten out by the General Electric Co., Schenectady, N. Y. After a brief historical sketch of welding in the fabrication of steel structures, there is a short discussion of such parts of the construction as trusses, columns, beams and girders. It is probable that in the near future all building codes will permit welded structures.

609 **Springs.**—In spring design, unsatisfactory cut-and-try methods can often be obviated most readily by the use of a chart, which within its range of application gives its answer immediately or with a minimum amount of computation. Such a chart is presented on pages 4 and 5 of the April issue of Mainspring, published by the Wallace Barnes Co., Bristol, Conn. As always, in this publication, the clever illustrations add not a little to its attractiveness.

610 **Furnaces.**—The W. S. Rockwell Company has developed several types of carburizing furnaces. The rotary type, either electric or fuel, is described in their leaflet No. 296. The counterflow and straight line type continuous furnace is illustrated in leaflet No. 289, while No. 295 is devoted to the enclosed front type of furnace. These leaflets are punched so that they can be put in a binder for easy reference. W. S. Rockwell Co., 50 Church St., New York, N. Y.

611 **Alloys.**—A rather unusual color scheme catches the eye in the Index of "Alpro" Standard and Special Alloys prepared by Alloys & Products, Inc., Oak Point Avenue, New York, N. Y. The alloys are arranged in groups, each one classified as to purpose, with a cross index, classifying them according to their principal constituents, which makes this a valuable piece of literature to have on hand.

612 **The Homo Method.**—This is a highly accurate, automatic way of tempering large quantities of tools or production parts, and of securing an extremely uniform temper. It is used for needles, springs, saws, drills, etc., and for heat-treating various non-ferrous metals. Catalog No. 93 of the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., goes into the process in great detail and shows a number of installations of the furnaces.

613 **Indium.**—A short paragraph on this rare metal is only one of the several interesting articles in the May issue of the Industrial Bulletin put out by Arthur D. Little, Inc., Cambridge, Mass. This periodical always has up-to-the-minute information on timely subjects.

614 **Recording Instruments.**—Bulletin No. 380 of the Bristol Company, Waterbury, Conn., is intended to give some idea in regard to the very complete line of Bristol's instruments for recording, indicating and controlling. It does not include prices of the instruments which are illustrated but it emphasizes the simplicity of principle and construction which features them.

615 **Laboratory Equipment.**—"Electrify Your Laboratory" is the keynote of Bulletin 31A of the Precision Scientific Co., 1736 N. Springfield Ave., Chicago, Ill. Electric heaters for all laboratory operations in which gas is ordinarily used are illustrated, from special heaters for Kjeldahl flasks to heaters to replace the usual Bunsen burner.

616 **Spectrum Analysis in Mineralogy.**—A 52-page booklet with this title has been written by A. A. Fitch for Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, England. Some of the chapter headings which will indicate the scope of the book are: "Technique of Spectrum Analysis; Qualitative and Quantitative Analysis of Minerals; Analysis of Rocks, Meteorites, and Natural Waters; X-Ray Spectrum Analysis of Minerals. A nominal charge of 1s. 11d. is made for the book.

617 **Cadmium Plating.**—Udylite's Relation to the Automotive Industry is the feature article of the May 1931 issue of The Udylite News, 3220 Bellevue Ave., Detroit, Mich. Numerous parts of automobiles are continually subjected to rust and corrosion and can be protected by Udylite plating.

618 **Permabrite.**—A new high strength, light weight aluminum alloy has been developed by the Apex Smelting Company, 2554 Fillmore St., Chicago, Ill. Their Bulletin No. 1 gives the mechanical and physical properties of this new alloy and suggests some uses for it.

619 **Electric Resistors.**—Bulletin No. 6 of Ryan, Scully & Co., Philadelphia, Pa., gives a full description of their electric furnace metallic resistors, showing their adaptability to new and old furnace installations, and their general construction features. Bulletin No. 9 of the same company is devoted to their electric pot type furnaces which are used in heat treating operations which demand a close accuracy of heat penetration and an entire elimination of surface scale.

620 **Nickel and Monel Metal.**—The International Nickel Co., 67 Wall Street, New York, N. Y., has published a convenient list of their literature for those who are interested in securing data on the properties and uses of Monel metal and nickel.

621 **Tubular Electric Immersion Heaters.**—Bulletin No. 250 of H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa., is a supplement to their various publications on large melting and coating tanks for asphalts, tars, oils, varnishes and similar viscous substances. It points out the advantages of the tubular electric over the tubular fluid immersion heaters.

622 **Electric Heating Elements and Units.**—Leaflet TA-30 of the Harold E. Trent Co., 618 N. 54th St., Philadelphia, Pa., gives a short descripton of their strip, tubular and ring heating units and includes a price list.

623 **Hydrogen Ion Potentiometer.**—It is the purpose of Bulletin 766 of the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., to describe a potentiometer sufficiently accurate for all general laboratory work and even for most research involving determination of hydrogen ion concentration, while at the same time it is sufficiently convenient for routine work.

624 **Carboloy.**—The purpose of this publication is to disseminate all the news on what is being done with the product by that name so that users may know what they can expect from their own applications of Carboloy tools. The Feb.-Apr. issue has several interesting uses of such tools and two data sheets which should be convenient. Carboloy, 2481 East Grand Boulevard, Detroit, Mich.

625 **Oil Burners.**—Ryan, Scully & Co. burner equipment meet the wide diversity of requirements for low pressure air atomization and accurately fit in with automatic combustion and temperature control systems. Type A, for general combustion conditions, Type B, for special minimum capacities, Type C, for heavy oil and preheated air, are described in their Bulletin No. 2. Ryan, Scully & Co., 3711 Wissahickon Ave., Philadelphia, Pa.

626 **Furnaces.**—The Surface Combustion Corporation, Toledo, Ohio, has prepared a new folder about their furnaces for carburizing and hardening auto fan shafts with the utmost in economy, uniformity of quality and reliability. The furnaces are described in detail and performance data is given.

627 **Material Handling.**—The Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill., is preparing a series of data sheets on Material Handling & Power Transmission Data, one to be issued each month. These will cover important phases of these subjects about which little has been published. Data sheet No. 1 is entitled "Belt Conveyor Trajectory Chart and Data."

628 **Amsco Bulletin.**—The feature article in the May issue of this periodical is "A Trip Through South America" written by an engineer of the American Manganese Steel Company, and a number of minor articles show various applications of their products. St. Louis, Mo.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS OF METALS & ALLOYS

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Note. The September issue of METALS & ALLOYS will be Vol. 2, No. 3. For purposes of binding and filing, these monthly bulletins may be considered as Vol. 2, No. 2a, 2b, etc

These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class.
The remittance should accompany the order.
Book Reviews are included below and marked by -B-

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PATENT SERVICE

Until we resume regular publication in September, the service rendered by the Patent Department of METALS & ALLOYS will be carried on by Mr. W. M. Corse, 810 Eighteenth Street, Washington, D. C., who can supply copies of United States and foreign patents and translations at reasonable costs.

GENERAL (0)

Ideal and Practical Relations between Elasticity and Plasticity, Tenacity and Brittleness. (Begriffliche und prüfmethodische Beziehung zwischen Elastizität und Plastizität, Zähigkeit und Sprödigkeit.) A. SCHOB. (Materialprüfungsamt, Berlin.) *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 56–62, 2 figures, 31 references.

States definitions for these properties and gives annotated bibliography. HWG(0)

Physical Chemistry of Metallurgical Reactions. A Manual of Theoretical Metallurgy. (Physikalische Chemie der metallurgischen Reaktionen. Ein Leitfaden der theoretischen Hüttenkunde.) FRANZ SAUERWALD. Julius Springer Verlag, Berlin, 1930. Paper, 6 1/2 × 9 1/2 inches, 142 pages. Price 15 RM.

This book is divided into 3 parts, which will be considered in order. Part 1 is a review of the quantitative treatment of chemical reactions. In 30 pages the author skims over the following fundamental theoretical subjects: homogeneous equilibrium and the law of mass action; heterogeneous equilibrium from the standpoint of the Nernst partition law and the phase rule; chemical affinity and the first, second, and third laws of thermodynamics; reaction velocity, both homogeneous and heterogeneous. The treatment of these important concepts is obviously quite superficial and can be considered as little more than a listing of the basic laws and equations which are of particular importance to the metallurgist. The author uses Nernst thermodynamic notation and "chemical constants," which is unfortunate in the light of the more concise and accurate treatment as developed by G. N. Lewis and his collaborators.

Part 2 is a discussion of fundamental metallurgical reactions. Two component systems with gas phase are considered first. Metal-oxygen systems are presented for the metals: Ag, Cu, Pb, Cd, Ni, and Fe. Numerous references are quoted and equilibrium data are presented, with a discussion of the thermodynamics of these reactions. Both P-T and C-T diagrams are included where data are available.

Metal-sulphur systems follow, including the metals: Ag, Pb, Ni, Fe, and Cu. This discussion is brief, since experimental data are meager.

Three component reduction equilibria are discussed for systems of the type: metal-oxygen-hydrogen, metal-carbon-oxygen, metal-sulphur-oxygen. Experimental methods are briefly indicated and the more important equilibria are then discussed in some detail. Six pages are devoted to the various equilibria involved in the combinations, iron-iron oxides-CO/CO_2-C, etc. The work of Maier and Ralston on the reaction $ZnO + CO = Zn + CO_2$ is presented. The equilibria in the system Pb–S–O are included in this chapter along with other less important reactions. The thermodynamic treatment of the data for these reactions is far from satisfactory. No attempt is made to express either equilibrium constants or free energies as a function of the temperature, even when such equations have been previously developed, as in the excellent work of Maier and Ralston mentioned above.

Part 3 is a brief discussion of some applications of physical chemistry to technical metallurgical processes. This chapter is mainly qualitative in character. The more recent experimental studies of blast furnace reactions and the investigations of open-hearth reactions by Herty, Schenk, and others are reviewed. The Ag-Pb-Zn ternary diagram and its application in the Parkes Process are discussed.

It is the opinion of the reviewer that this book should be of considerable interest to the modern metallurgist, if for no other reason than that it points out the possibilities of physical chemical treatment of metallurgical reactions. Unfortunately the development of the theory is too brief to be of use to anyone not already well versed in the subject. The unsatisfactory thermodynamic treatment in this book can be contrasted with the concise treatment employed in the recent metallurgical publications of the Bureau of Mines by Dean, Davis, Maier, Prescott, and others.—Harry Seltz (0)-B-

PROPERTIES OF METALS (1)

Structure and Life of Metals. (Bau und Leben der Metalle.) P. LUDWIK. *Metallwirtschaft*, Vol. 9, Feb. 7, 1930, pages 129–133.

Lecture before the Gewerbeverein in Vienna. The author gives a general description of atomic structure, crystal formation, lattice construction, inter and intra crystalline fracture, crystal growth and refinement, recrystallization, solid solutions. He gives as illustrations the difference between the diamond and graphite, structure of aluminum alloys, overheating of steel, cold working and recrystallization of brass, carburizing and hardening of steel, and the aging of Al alloys. He contends that metals are not dead, but that, similar to plants, they have life, as they grow, combine, divide and regenerate. CEM(1)

The Physical Properties of Rhenium. (Die Physikalischen Eigenschaften des Rheniums.) C. AGTE, H. ALERTHUM, K. BECKER, G. HEYNE & K. MOERS. *Naturwissenschaften*, Vol. 19, Jan. 30, 1931, pages 108–109.

Crystal structure: close-packed hexagonal, having the following lattice constants, a = 2.765 A. U., c = 4.470 A. U., c/a = 1.616. *Melting point:* 3440° ± 50° absolute. *Mechanical properties:* density, measured on a sintered sample, 20.9 (calculated from X-ray data, 21.4—from this the atomic weight, 186.31 ± 0.02, has been obtained); tensile strength, 50.6 kg./mm.²; percentage elongation, 24. *Electrical properties:* electrical resistivity = 0.21×10^{-4} ohm-cm. at room temperature; temperature coefficient of resistivity between 0° C. and 100° C. = 3.11×10^{-3} and between 0° C. and 2710° C. = 1.98×10^{-3}; electron emission: measurements of the electron emission between 1900° and 2700° absolute give for the constants in Richardson's emission formula ($i = AT^2 \times e^{-b/T}$) the following values:

$$A = 200 \times \frac{\text{Amp.}}{\text{cm.}^2 \times \text{Grad.}^2} \text{ and } b = 59{,}500.$$

OWE(1)

The Heat Capacities at Low Temperatures of Antimony, Antimony Trioxide, Antimony Tetroxide and Antimony Pentoxide. C. TRAVIS ANDERSON. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2712–2720.

The heat capacities of antimony and its oxides have been determined and their entropies calculated for the range 60 to 300° K. Heat of formation of the trioxide has been calculated. MEH(1)

The Heat Capacities of Bismuth and Bismuth Trioxide at Low Temperatures. C. TRAVIS ANDERSON. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2720–2723.

The heat capacities of bismuth and its trioxide have been determined from 60–300° K., and their corresponding entropies calculated. The free energy of the oxide has also been calculated. MEH(1)

Some Properties of Metallic Cadmium. G. D. PRESTON (National Physical Laboratory). *Institute of Metals, Advance Copy* No. 556, 1931, 32 pages.

Hardness and tensile values of rolled Cd show that the temperature of working has a pronounced effect on these properties. In ordinary tests the worked Cd appeared to be stronger than the cast, but the conditions were reversed in the long-time ball test. Material in the cold rolled condition was completely recrystallized. In such material appreciable grain growth was found after 5 years. No evidence was found of an allotropic transformation. By X-ray examination the parameter of the unit cell was found to be a = 2.9724 ± 0.0005 A. U., with an axial ratio of 1.8854 ± 0.0005. In cold rolled Cd the 10.1 plane tends to lie on the surface, and the normal to the 00.1 plane is inclined at about 65° to the normal to the sheet. In hot rolled sheet another preferred orientation is found. 17 references. JLG(1)

The Vapor Pressure of Sodium. Low Pressure Measurements with the Absolute Manometer. WORTH H. RODEBUSH & WM. F. HENRY. *Journal American Chemical Society*, Vol. 52, Aug. 1930, pages 3159–3161.

Vapor pressure of sodium between 396.5° and 263.0° C. are given. At the former temperature the vapor pressure equals 0.3025 mm. MEH(1)

The Economic Significance of Zirconium and Its Compounds. J. F. CORRIGAN. *Industrial Chemist*, Vol. 7, Mar. 1931, pages 97–100.

A good review; 12 references. Sources of Zr are discussed and its minerals listed. Zr is now obtained by alumino-thermic reduction 99.5% pure. Earlier methods of production are described. Properties of Zr: a steel-gray metal capable of taking a high polish; does not rust or tarnish; melts at approx. 1600° C.; resembles Fe as an electrical conductor; scratches glass; it readily combines with O_2, H_2, N_2, C, Si, and B; it forms alloys with the ferrous metals and with Ag, Al, Mg, and others, but not with Sn, Pb, the alkalies, or the alkaline earths; it reduces SiO_2, TiO_2, and B_2O_3 at high temperatures. The nitrides of Zr give off NH_3 under certain conditions when treated with H_2 or water, suggesting a use for the metal in nitrogen-fixation. Zr steels are very tough. Ferro-zirconium is obtained with a Zr content ranging between 40 and 90%. A well-known alloy of Zr and Ni is "Cooperite." An alloy containing 65% Zr, 26% Fe, 7.7% Al and 0.12% Ti is very resistant to chemicals, takes a high polish, is very malleable, and may find a use in light filaments. ZrO_2 melts at 2900° C., has a low thermal and electrical conductivity, low coefficient of expansion, and very low porosity; it makes an excellent refractory, and is also used in enamels. MPB(1)

The Optical Determination of High Metallurgical Temperatures. The Melting Point of Fe. C. H. M. JENKINS & MARIE L. V. GAYLER. *Proceedings Royal Society*, London, Vol. 129A, Sept. 3, 1930, pages 91–114.

The melting point of Fe has been determined by 2 methods. In one a closed refractory tube is immersed in the center of a mass of metal to serve as a black body enclosure for sighting an optical pyrometer. In the other a bubble is blown down into a surface of metal. The pyrometer was calibrated by observing the E.M.F. of Pd thermocouple in a black body enclosure. The m. p. of Pd (1555° C.) is indicated by the breaking of the metallic circuit, and over a further temperature range by means of the sector method, using the m. p. of Au (1063° C.) as the other fixed temperature. The m. p. of Fe was found to be 1527° ± 3° C. Refractories were made of hard pure alumina. Difficulties were also encountered in that metal vapors penetrated the refractories and emitted radiations to the pyrometer on condensation, but this difficulty was overcome by ventilation with H_2. HCD(1)

The Technical Preparation of Dvi-Manganese. I. G. F. DRUCE. *Industrial Chemist*, Vol. 7, Feb. 1931, pages 75 and 79.

Dvi-manganese or rhenium, atomic number 75, was discovered in 1925. It occurs in crude manganese salts and in some molybdenum preparations, but always in very small amounts. Two processes patented by Germans for preparing (1) nearly pure metal and (2) potassium perrhenate, are described. About 120 kg. of the potassium salt are at present available. Rhenium promises to afford a new catalyst, and its salts may find uses as reagents for potassium. No other applications have yet been found. 6 references. MPB(1)

An Allotropic Transformation of Calcium in the Solid State. (Sur une Transformation Allotropique du Calcium à l'État Solide.) E. RINCK. *Comptes Rendus de L'Académie des Sciences*, Vol. 192, Feb. 16, 1931, pages 421–423.

Heating and cooling curves of calcium show an inversion at 450° C. A study of this phenomenon has shown that calcium exists in two allotropic varieties—a form α, stable at temperatures below 450° C., and a form β, stable between 450° and 850° C., the melting point of pure calcium. Measurements of the electrical resistivity of calcium are given, and values for the coefficient of electrical resistivity are quoted. Rinck was unable to retain the β-phase by quenching from temperatures above the transformation point. OWE(1)

The Measurement of the True Specific Heat of Solid and Liquid Metals at High Temperatures. (Ueber die Messung wahrer spezifischer Wärmen fester und flüssiger Metalle bei hohen Temperaturen.) H. SEEKAMP. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 195, Feb. 7, 1931, pages 345–365.

The author describes a process for the measurement of the true specific heat in which a tungsten spiral is employed as the source of energy. Complete details of the method of supporting the spiral within the sample of metal to be investigated are given, the article being accompanied by 4 diagrams describing the apparatus used and the electrical equipment employed in connection with the experiments. Particulars are given of the results of experiments on Cu, Al, and Mg, the true specific heats of which were measured in the solid state. Curves are given showing the relationship between the results and those of previous workers in this field. The second part of the paper deals with the application of this method to the investigation of liquid metals. In this case, the tungsten spiral is protected by means of a porcelain sleeve. Measurements of the true specific heats of solid and of liquid Th were made from the range of 18° to 500° C. It is shown that Th undergoes a transformation at the point of 226.7° C., the heat of transformation amounting to 98 cal./g.-atom. OWE(1)

Cadmium. *Chemical Engineering & Mining Review*, Vol. 23, Jan. 5, 1931, pages 145–146.

The properties, sources, and uses of Cd are discussed. In Australia it has been found that an alloy containing 96.7% Cd, 3.1% Cu, and 0.1% Mg has outstanding qualities as a bearing metal. The physical properties of this alloy are compared with those of a commercial white metal containing 88% Sn, 9% Sb, and 3% Cu. WHB(1)

The Independence of the Hardness and the Hydrogen Content of Electrolytic Metals. (Sur l'Independance de la durete et de la Teneur en Hydrogene des Metaux Electrolytiques.) GUICHARD, CLAUSMANN, BILLON & LANTHONY. *Comptes Rendus*, Vol. 192, Mar. 9, 1931, pages 623–625.

The authors point out that the exceptional hardness of electrolytic iron has for a long time attracted attention. This hardness has been attributed, on the one hand, to the fine state of diffusion of the metal and, on the other, to the presence of a compound of hydrogen and iron having a characteristic metallographic structure. The authors have repeated the experiments of Hughes (*Revue de Metallurgie*, Vol. 22, 1925, page 764) and have arrived at a conclusion entirely different from that reached by him. The results of their experiments are briefly described and they conclude that it is necessary to exercise considerable caution before attributing the remarkable mechanical properties of electrolytic metals to the presence of occluded gases. The article is illustrated by 1 diagram and 6 photomicrographs. OWE(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

The Platinum-Iridium Alloys. FRANZ KORN. *Metal Industry*, London, Vol. 38, Mar. 20, 1931, pages 309–310.

Platinum-iridium alloys have high strength, a faint blue color, and are resistant to tarnishing. The tensile strength varies from 30 tons/in.^{2} with 5% Ir to 97 tons/in.^{2} with 30% Ir. Alloys containing more than 12% Ir increase in tensile strength when annealed between 600° and 800° C. Annealing temperatures should never be above 950° C. especially for alloys with more than 15% Ir, some of which is lost by volatilization. Corrosion resistance to hot aqua regia and sulphuric acid increases with Ir additions. Pd does not harden Pt alloys as effectively as Ir. Au increases both hardness and brittleness of Pt but the brittleness is counteracted by Pd. The Pd content should be 2 or 3 times the Au content to obtain best results with Pt-Pd-Au alloys. PRK(2)

White Metals, Brasses, and Bronzes. Pts. VI & VII. E. PERRY. *Metal Industry*, New York., Vol. 28, Aug. 1930, pages 376–377; Oct. 1930, pages 464–465.

Pt. VI. In Cu-Zn alloys, the alloy is usually of a red color when 85% or more of Cu is present. In making red brasses, Cu is melted first and other metals are added in the same manner as followed in yellow brasses. Clean flux should be used. Gives composition of a few representative brasses. Cu and Sn alloys with more than 5% of Sn are known as bronze. Bronze is made in the same way as brass. Bronze mixtures should be deoxidized with P-Cu or P-Sn except in the case of Al and Si bronzes. Includes a table giving standard and special bronze mixtures, illustrating some of the better combinations for certain purposes. Pt. VII. White brass and bronze alloys are usually very hard and, many of them, extremely brittle. In melting, the volatile metal is melted first, or in the case of 2 or more volatile metals, they are melted together. White metals proper are made without Cu. They are used for patterns, letters, ornaments, dishes, type-metal toys, etc. Includes tables showing typical mixtures of white brasses and white metals. VSP(2)

Commercial Aluminum Alloys from the Users' Point of View. J. B. HOBLYN. *Metal Industry*, London, Vol. 35, Dec. 20, 1929, pages 589–590. See *Metals & Alloys*, Vol. 1, July 1930, page 627. (2)

Dimensional Stability of Heat Treated Aluminum Alloys. J. D. GROGAN & D. CLAYTON (National Physical Laboratory). *Institute of Metals, Advance Copy* No. 553, 1931, 28 pages.

It was found that the change in length of both cast and forged heat treated aluminum alloys over a period of years was inappreciable. Changes in length on machining these alloys, however, may occur. Samples of Y-alloy, Duralumin, and 25S 3 in. in diameter by 5 in. long were heat treated and machined into dumb-bell form. As the outer surface was removed appreciable shrinkage occurred in the fully aged alloys. The shrinkage was greatest in those quenched in cold water, less in those quenched in oil and almost negligible in those quenched in boiling water. The decrease in length in some cases amounted to almost 0.020 in. Tensile and hardness tests indicated that the alloys quenched in boiling water were as effectively hardened as those quenched in cold water. Dimensional changes on machining did not occur in annealed alloys. The corrosion resistance of the hot-water quenched alloys may be low, and the greater resistance of the cold-water quenched alloys may result from compressive stresses in layers near the surface, which heal intercrystalline corrosion cracks. Contains 1 reference. JLG(2)

New Silicon-Zinc-Copper Alloys. Part I. The Use of Silicon as a Deoxidizer and Alloying Agent.—Preparation of the Alloys.—Determination of Solid Solubility Limits.—Mechanical and Physical Properties. E. VADERS (Hirsch, Kupfer- und Messingwerke A.-G.). *Metal Industry*, New York, Vol. 29, Mar. 1931, pages 108–110.

Using electrolytic Cu, pure Zn, and Si with an Fe content of 1–2%, alloys up to 6% Si were melted in a high frequency induction furnace. The solubility of Si is shown by straight lines through the points Cu 95, Zn 0, Si 5; Cu 79, Zn 18, Si 2; Cu 71.1, Zn 27, Si 1.9 in a ternary diagram. The physical properties of 10 alloys are given, tensile strengths varying from 23.4 to 50.8 kg./mm.^{2}, elongation from 2.2 to 28.3% and Brinell hardness (100 kg. load) from 77 to 140. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. PRK(2)

Beryllium-Copper Alloys. EDMUND R. THEWS. *Canadian Chemistry & Metallurgy*, Vol. 15, Feb. 1931, pages 51–53.

Properties of Be and its alloys are reviewed. Be-Cu alloys include those with Be used as deoxidizing agent and containing 0.01–0.03% and with Be as alloying agent containing 1–3% Be. Age-hardening of these alloys does not depend upon the quenching medium. The effects of age-hardening on the mechanical properties of various Be-Cu alloys are indicated. The elasticity of Be-bronze is exceedingly high and these bronzes exhibit very good bearing qualities. Castings are free from pores and surface defects. A bibliography of seven references is included. WHB(2)

Effect of Combinations of Strain and Heat Treatment on Properties of Some Age-Hardening Copper Alloys. W. C. ELLIS & EARLE E. SCHUMACHER (Bell Telephone Labs.). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 395, 1931, 13 pages.

Cu-Ni-Si and Cu-Co-Si alloys were studied. By heat treating and cold drawing an alloy containing 4% Ni + Si a tensile strength of 140,000–150,000 lbs./in.^{2} with an elongation of 30–33% was obtained. With 1% Co + Si the tensile strength was 85,000 and the conductivity 50%. Reheating to low temperatures increased the conductivity and slightly decreased the strength. Contains 3 references. JLG(2)

Compression Diagrams and Temperature-Hardness Curves of Some Lead-Tin-Antimony Alloys. (Stauchdiagramme und Wärmehärtekurven einiger Legierungen auf Blei-Zinn-Antimon-Basis.) EDUARD HERTEL & ARTHUR DEMMER. *Metallwirtschaft*, Vol. 10, Feb. 13, 1931, pages 125–126.

Compression stress-strain diagrams were prepared for 12 Pb-Sn-So alloys, using samples 20 mm. diam. and 25 mm. high and applying the load at the rate of 0.1 mm. per sec. These results and Brinell hardness tests are shown in the tabulation. In 10 X-ray examinations, the existence of a tetragonal Sn rich, a trigonal Sb rich, and a cubic constituent was found and the absence of any definite Sn-Sb compounds was proved.

	Composition							Load, kg./mm.^{2} at Compression					Brinell Hardness at		Ratio
No.	Sn	Pb	Sb	Cu	Ni	Mg	P	0.2%	0.4%	0.9%	1.8%	3.6%	20° C.	100° C.	$\frac{0.4\%}{0.2\%}$
	100							2.51	2.94	3.40	3.7	4.03	12.8	5	1.17
		100						2.07	2.58	3.08	3.39	3.69	6.1	3.8	1.24
			100					5.31	8.64	12.54	Broke	...	49.0	34.5	1.06
				100				..	..	..	...	...	63.0	57.0	..
I	50	50						2.57	4.09	4.77	5.20	5.49	14.5	6.8	1.59
II	48	48	4					3.42	4.59	5.56	5.81	5.86	18.6	8.0	1.34
III	44	44	12					4.26	..	7.00	7.47	7.77	24.9	9.5	..
IV	42	42	16					4.36	6.04	7.95	8.51	8.84	28.4	13.0	1.36
V	40	40	20					4.87	6.53	8.86	9.75	10.19	30.0	13.5	1.33
VI	40	40	15	5				5.11	7.33	9.89	10.45	10.87	43.0	22.8	1.43
VII	40	45	10	5				4.44	6.87	9.39	9.98	10.23	30.4	12.4	1.54
VIII	40	40	15	3	2			4.78	7.10	9.89	10.40	10.67	29.7	15.9	1.48
IX	40	40	12	3	5			2.55	3.10	5.17	6.71	6.87	31.2	17.2	1.21
X	40	40	9	3	8			..	..	..	...	....	34.5	17.8	..
XI	40	40	15	3		2		4.97	6.20	8.12	8.86	9.30	..	..	1.24
XII	42	42	10	2		2	2	4.40	6.16	7.21	8.01	8.62	..	..	1.40

CEM(2)

PROPERTIES OF FERROUS ALLOYS (3)

Production and Properties of Stainless Steels. (Die rostfreien Stähle ihre Eigenschaften und Herstellung.) E. HOUDREMONT. *Krupp'sche Monatshefte*, Vol. 11, Nov. 1930, pages 270–286; *Revue de Metallurgie*, Vol. 28, Jan. 1931, pages 40–59.

The article corresponds to the publication in *Stahl und Eisen*, Vol. 50, Oct. 30, 1930, pages 1517–1528, reviewed in *Metals & Alloys*, Vol. 2, Jan. 1931, pages 31–33, and abstracted in Mar. 1931, page 63. GN(3)

Stainless Steels. V. V. KENDALL. *Metals & Alloys*, Vol. 2, Jan. 1931, pages 31–33.

A critical abstract. Original article appeared in *Stahl und Eisen*, Vol. 50, Oct. 30, 1930, pages 1517–1528. See abstract in *Metals & Alloys*, Vol. 2, Mar. 1931, page 63. ESC(3)

Hardenable Titanium Alloys. (Vergütbare Titan-Legierungen.) W. KROLL. *Metallwirtschaft*, Vol. 9, Dec. 19, 1930, pages 1043–1045.

Pure titanium is prepared by reducing $TiCl_4$ in an evacuated steel bomb with Na at 500° C. It can be hammered and rolled. Rockwell hardness C 36, melting point 1850° C., silver color. Its affinity toward O_2 is between Si and Al and it can be used to deoxidize steel. Technical Ti is produced by the alumino-thermic process with addition of S and contains about 20% Al. Ferrotitanium containing 20% Ti, 5% Al is prepared from ilmenite by reduction with ferroaluminum, and cuprotitanium contains 15% Ti and much Al. Ferrotitanium containing C is also produced by reducing ilmenite in an electric furnace with coal. An Al alloy with 0.5% Ti, also Cu and Si, has good casting properties. Low carbon Ti steel was produced by melting Armco iron and ferrotitanium in a high frequency furnace. Ti has little effect except in high percentages and then forms coarse grained steel. Ti hardens Ni steel when drawn 12 hours at 500° C. With 2.16% Ti, 10% Ni, 0.05% C Brinell hardness is 490, with 4.4% Ti, 12.5% Ni Brinell 615. Quenched in water at 950° C. the hardness was 285 and 350, respectively. The addition of Ni to Ti steels produces a much finer grain size. Steel containing 3.11% Ti, 20% Cr, and 5% Ni was 300 Brinell when quenched from 950° and 525 Brinell when quenched and drawn at 500° C. These alloy steels can be easily rolled. They must be cast immediately after adding the Ti to prevent formation of nitrides. The hardening effect is explained by the precipitation theory. CEM(3)

A Study of the Physical Properties of Electrolytic Cobalt and Its Alloys with Iron. W. C. ELLIS (Thesis for Ph. D.). *Rensselaer Polytechnic Institute, Engineering and Science Series*, No. 16, June 1927, 57pages. Bibliography of 31 titles.

Seven alloys of electrolytic cobalt and electrolytic iron, as well as the 2 metals themselves, were studied, chiefly in regard to magnetic and electrical properties. The cobalt was 99.91%, with 0.07% Fe, 0.02% Cu. Specific resistance of cobalt of this purity is 6.24 microhm cm. at 20° C., temperature coefficient (0–100°) 0.00604. At 446° C. on heating, cobalt changes from close-packed hexagonal to face-centered cubic. On cooling, the reverse change occurs about 50° lower. Above 446°, cobalt can be readily worked, below it, it is rather brittle. Small amounts of iron give alloys that are face centered cubic and workable, hot or cold. The inversion point does not show up in thermo-electric measurements. Alloyed with electrolytic iron of 99.965% purity (chief impurities 0.015% Cu and 0.006% C) the alloys at both ends of the range were ductile cold, but between about 30 and 80 atomic % iron, they were not ductile cold, and had to be hot-swaged. The whole range of alloys forged hot. Up to $66^2/_3$ atomic % cobalt, the iron cobalt alloys are body centered cubic in form. At 80 and above atomic %, the structure is γ, face-centered cubic. No compound was indicated by X-ray analysis. Lattice parameters, resistivities, temperature coefficients, thermo electric force, magnetization and permeability curves are given for the various alloys studied. Work of previous investigators on less pure materials had indicated remarkable magnetic properties for an alloy corresponding to Fe_2Co which were not confirmed in this work and it is suggested that the presence of silicon may be required to secure the properties previously ascribed to that composition. The work of previous investigators on the Fe–Co system is summarized. HWG(3)

Magnetic Properties of Nickel Alloys. (Proprietes magnetiques des alliages de nickel.) MARCEL BALLAY. *Industrie Electrique*, Vol. 39, Nov. 1930, pages 511–519.

Electric properties of Fe-Ni, Ni-Cr, Fe-Ni-C, Fe-Ni-Co and monel metal taken largely from American sources are given. JDG(3)

The Correlation of Mechanical Tests for Cast Iron. J. G. PEARCE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Dec. 1930, pages 673–720.

Conditions of melting, composition and rate of cooling have a profound influence on cast-iron structure, hence their mechanical properties. The influence of the former is pronounced and surpasses minor differences in composition and section. Pearlite or the ferrite structure may be produced in irons of the same composition by variations in the melting practice. The strength varies continuously with section for bars cast at different diameters. Such changes cannot be represented by a simple physical law. Variations of physical properties with composition and size of section are given in numerous graphs. CHL(3)

Materials at High Temperatures, General Properties, Limiting Creep Stress and Limit of Proportionality. R. G. BATSON (National Physical Laboratory, England). *First Communications of the New International Association for the Testing of Materials.* Group A, Zurich, 1930, pages 74–79.

General discussion of the problem. Hatfield's "time-yield" short-cut method is mentioned, but Batson believes that only long duration tests which give a minimum creep rate of 10^{-5} inches per hour are adequate. See also *Metals & Alloys*, Vol. 1, Nov. 1929, page 241. HWG(3)

The Structure and Mechanical Properties of Pearlite. (Sur la perlite, sa structure et ses proprietes mechaniques.) N. T. BELAIEW. *Revue de Metallurgie*, Vol. 27, Dec. 1930, pages 680–685. 15 references.

The actual distance between lamellae of cementite and ferrite in pearlite is constant for all grains of a given specimen and is governed by the rate of cooling. Brinell hardness is unaffected by the grain size but is in direct relation to intralamellar distances. So that the latter can be derived directly from Brinell hardness properly accounting for the influence of other alloys present. JDG(3)

The Properties of Silicon Cast Steel (Ueber die Eigenschaften von Siliziumstahl in Form von Stahlguss). F. BONSMANN. *Mitteilungen Forschungs-Institut Vereinigte Stahlwerke Aktiengesellschaft Dortmund*, Vol. 1, No. 6, 1929, pages 147–176, 21 references.

A comparative study of 6 cast steels containing 0.14–0.18% C, 0.7–1.2% Mn, 0.7–1.3% Si, 0.3% Cu and 0.13% Ti, and of a plain C steel containing 0.39% C, 0.8% Mn and 0.45% Si. The Si steels exhibited a high degree of plastic deformation. As compared with C steel of the same tensile strength, the Si steels show better elongation, reduction of area and notch toughness. Elongation and reduction of area of the Si steel are 60% higher than those of the plain C steel. The notch toughness is about 80% higher in the Si steel than in the plain C steel. The best tensile properties are obtained by heating the Si steels at temperatures between 900° and 1000° C. Si steels require an annealing at 100–150° C. higher than the C steel. Tensile properties of the Si steel depend on the temperature. By adding 0.3% Cu, the Si steel becomes more resistant to corrosion. See article bearing the same title by Schulz and Bonsmann, *Metals & Alloys*, Vol. 1, Aug. 1930, page 690. GTM(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion Resistance of Aluminum and Its Alloys. (Korrosionsfestigkeit des Aluminiums und seiner Legierungen.) M. BOSSHARD (Aluminium-Industrie A.-G., Switzerland). *First Communications of the New International Association for the Testing of Materials.* Group A, Zurich, 1930, pages 293–303, 15 references.

Corrosion studies of aluminum with various contents of Si and Fe, by determination of temperature rise (reaction rate) in HCl, and by loss of weight in $NaCl$-H_2O_2, are described, on material after different degrees of cold working and different annealing treatments. The results of the 2 methods are not always consistent. The influence of Cu, Zn, Mg, and Mn is discussed. Potential measurements in 1% NaCl quiet, in 2% NaCl aerated, and in 1.3 N HCl and 1 N KCl are tabulated, from the literature, for the more common metals. The data for 2% NaCl aerated are extended to a dozen commercial aluminum alloys. Corrosion resistance depends on formation of a protective oxide skin. Pitting is due to electrochemical attack on this coating. HWG(4)

Corrosion Observations on Copper Bearing Steels (Erkenntnisse über den Korrosionsvorgang aus der Korrosion gekupferten Stahls). C. CARIUS (Vereinigte Stahlwerke Dortmund). *Zeitschrift für Metallkunde*, Vol. 22, Oct. 1930, pages 337–341; Discussion, Nov. 1930, pages 392–393.

The author investigated the mechanism of corrosion on Cu-bearing steels and discovered Cu deposited at the surface. In distilled water the metal deposited stuck tightly to the steel while rusting in salt solutions yielded spongy Cu-films which flaked off. The nature of the deposited metal decisively affected the developing process of rusting. By means of solutions containing Fe^{II} and Fe^{III} salts, Carius explains the reactions encountered in such oxidation-reduction-chain. By comparing the oxidation potential of an aqueous corroding medium with the magnitude of the potential of a metal against the corrosive medium, the corrosion stability of the metal in this solution can be anticipated. By a comparison of the oxidation potential of an aqueous medium with the position of the potential of a metal toward that reagent, the resistance of the metal may be forecast. Paper at the Corrosion Meeting of the Deutsche Gesellschaft für Metallkunde. EF(4)

Results of Water Treatment. T. F. POWERS. *Railway Age*, Vol. 90, Feb. 7, 1931, pages 329–331.

From a paper "Feedwater and Its Relation to Boiler Troubles" before the Western Railway Club, Chicago, Dec. 1930. Water treatment on the Chicago & North Western has cut down the failures due to leaky flues from one for each 58,633 miles in 1911 to one for each 4,343,302 miles in 1929. Wayside treating plants under proper supervision is the most satisfactory method. Since 1911 trouble has been encountered with the embrittlement of boiler plates in the shells of locomotive boilers. The characteristics associated with this trouble are: it is confined to certain definite districts; it is more prevalent in locomotives in passenger service; the cracking is generally discovered below the water line; in horizontal seams it is always confined to the outside row of rivets; it appears always to start from the dry side of the plate; before failure occurs, the cracks are generally discovered by small hairline cracks which readily open up under heat; there is no elongation of the plates and, in many cases rivet heads break off before failure occurs; the cracks are very irregular but usually follow a general direction; the cracks seem to be more numerous and appear to start where the plates are not well laid up; in many of the cracked plates the chemical analysis shows that the steel manufacturers are complying with the specifications, although at the point of fracture decided crystallization is observed; the steel is very brittle and, in many cases, looks like cast iron. The theory that the cause of this cracking was due to poor material or poor workmanship was finally discarded. Localized strains combined with excessive use of sodium hydrate as determined by the work on this subject at the University of Illinois was considered the cause. Since it was impossible to relieve the strains, the feed water treatment was revised with a material decrease of the trouble. VVK(4)

Materials, Physical Properties and Corrosion. (Werkstoffe, physikalische Eigenschaften und Korrosion.) E. RABALD. Vol I. General and Metallic Materials. 976 pages. Vol. II. Non-Metallic Materials. 392 pages. O. Spamer, Leipzig, 1931. Paper, 7 × $9^3/_4$ inches. Price for both volumes 135 RM.

This huge compendium of the corrosion resisting properties of metallic and non-metallic materials is a "monumental work." It represents the labor of 5 years, and contains 10,000 references. The section on corrosion of iron and steel alone contains 2781 references, each one to an article that has been referred to in the text.

The volumes are chiefly a classified bibliography on corrosion, in which earlier texts have been freely used, but there is also considerable information on the physical properties of metals and alloys. The German standard specifications are given in many instances.

The books are written primarily from the point of view of the chemist. The effect of every chemical compound on whose corrosive action data are available, is entered under the various metals and alloys. Thus, one finds, for example, that 5% Maleic acid dissolves 0.093 g./dm.^{2} from Corronil in 500 hours, and that trichlorethylene dissolves 0.2 g./dm.^{2} from iron in 7200 hours. The books are rich in that sort of data, and while the test conditions can seldom be stated in detail, references to the original articles are given. Some 30 pages are devoted to the principles of corrosion, some 20 to methods of corrosion testing, and less than 20 to prevention of corrosion.

There is little attempt to deal critically with data found in the literature or to correlate laboratory tests and service results. Zinc coatings are discussed, but no mention is made of cadmium coatings.

Corrosion fatigue is barely mentioned, and its engineering importance is not brought out. The only inkling that weight losses may not tell the whole story in the corrosion of duralumin is contained in the comment that while the Mylius test is often used, Rackwitz and Schmidt measure the progress of corrosion by means of physical properties. In Fig. 128, tensile strength and elongation are plotted to show a drop in both with time of corrosion, but the ordinates are not given, and the text does not make clear whether the curve relates to duralumin or to aluminum alloys in general, nor what the conditions of corrosion were. Nothing is said about intercrystalline attack of duralumin. The engineering point of view is almost absent, and attention is focused on chemical attack.

The volume on non-metallic materials deals with glass, wood, cement, rubber, leather, tar, paints, varnishes, etc., etc.

The books are highly valuable as bibliographies, and their scope is larger than that of corrosion alone. For the metallurgist seeking an understanding of the mechanism of corrosion and the utility or otherwise of laboratory methods for accelerated corrosion testing, or for the engineer wishing to get an idea of what actual service he may expect of metals and alloys as structural materials under corrosive conditions, they cannot compare with the publications of Evans or Speller. But as a source of references to the general literature of corrosion, they are the latest and most complete.—H. W. Gillett (4)-B-

Recently Discovered Facts about Corrosion. F. N. SPELLER. *Metal Progress*, Vol. 1, Sept. 1930, pages 48–53.

A review of the methods of combating corrosion of ferrous materials. Protection by alloying, by coating with more resistant metals, and by painting is discussed. For brine circulation systems and other special cases the use of chemical agents to produce a "passive" film is often advantageous. Corrosion under stress, corrosion in steam plants, and soil corrosion are taken up. WHK(4)

Protection of Building Materials against Chemical and Physical Attack. (Schutz der Bauwerke gegen chemische und physikalische Angriffe.) O. GRAF & H. GOEBEL. Wilhelm Ernst & Sohn, Berlin, 1930. Paper, 7 × 10 inches, 224 pages. Price 22 RM.

The bulk of this book deals with concrete construction, with some attention to wood. About 40 pages deal with metals, some 25 being devoted to corrosion (written by H. Wolf), 3 pages by Graf dealing with high temperature properties of steel, wrought iron and cast iron in sketchy fashion, and the balance on protection of iron bridges against corrosion by K. Schaechterle.

Points of design so that water will drain off are brought out. The principles of corrosion are briefly discussed, and protective paints are very briefly dealt with. Various metallic coatings are mentioned. While the book will be of interest in regard to concrete, there is not much in it that will be new or very informative to the metallurgist.—H. W. Gillett (4)-B-

New Materials of Construction Reduce Corrosion Losses. JAMES A. LEE. *Chemical & Metallurgical Engineering*, Vol. 38, Mar. 1931, pages 153–154.

Paper before Technical Association of the Pulp and Paper Industry, Feb. 20, 1931. The 18% Cr, 8% Ni ferrous alloy when properly installed is valuable for resisting corrosion in sulphite mills. Modification of the composition of this alloy gives better corrosion resistance to sulphite as the following table indicates:

Corrosion Resistance of a "20–10" Cr-Ni Alloy 1% Sodium Bisulphite—3% Sulphurous Acid Temperature 300° F. Pressure 50–55 lbs./in.²

C	Cr	Ni	Mo	Loss/in.²/hr.
0.13	17.39	8.39	—	0.511 milligrams
0.12	20.39	10.76	—	0.182 milligrams
0.13	17.74	8.30	2.0	0.347 milligrams

Carbon is also used to resist sulphite corrosion, for instance in making tight joints in steam connections to paper machine drying cylinders, in replacing wooden suction boxes, and in digestor linings. Molded plastics are being used as scraping blades, impellors, gears, etc. PRK(4)

Protective Coatings, Rust Protection and Coloring of Aluminum. (Ueberzüge, Rostschutz und Färbung des Aluminiums.) HERBERT KURREIN. *Metallwirtschaft*, Vol. 9, Dec. 19, 1930, pages 1049–1050.

Al can be Cd plated in a solution of 11 g. $CdCO_3$, 35 g. $Cd(CN)_2$, 5 g. Na_3PO_4, 7.5 g. $K_4Fe(CN)_6$ and 2.5 g. gelatine/l. at 0.5–0.7 amps./sq. dm. and 3.5 volts. Cd gives protection against salt water. Cr cannot be plated directly on Al. Cr over Cd gives very good protection. Plated coatings on Al should be tested by determining the thickness by stripping, by bend tests and corrosion tests. The advantages of high strength Al alloys and corrosion resistant pure Al are combined in Allautal, Duralplat and Alclad, which consist of Al alloys with a layer of pure Al on each side, held mechanically by rolling together. The protecting layers are about 10% of the total thickness. Some protection is obtained by dipping Al in 10% NaOH, then 5 min. in conc. HNO_3 at 60° C. and anodic treatment in very pure chromic acid. By dipping in an almost boiling bath of 10 g. CaO and 10 g. $CaSO_4$/l. of H_2O a white or gray coat of $Al_2(SO_4)_3$ is formed. Al cannot be colored itself, except after plating with Cu, Ni or Fe. Black lines are formed by dipping in 10 g. $NiSO_4$, 5 g. Na_2SiF_6, 25 KNO_3 and 4 l. H_2O. CEM(4)

Acidity and Corrosion in Canned Fruits. E. F. KOHMAN & N. H. SANBORN (Research Laboratory, National Canners Association). *Industrial & Engineering Chemistry*, Vol. 22, June 1930, pages 615–617.

Data are presented to illustrate the effect of pH on the single and relative potentials of Fe (base plate) and Sn. It is probable that the effect of pH is more or less influenced by the acid radical of the acid used. Nevertheless, there is a tendency for the Sn to become less and less noble compared with Fe, as the pH becomes lower. This explains the perforation tendency of the less acid fruits in enameled cans. MEH(4)

Resistance of Stainless Steels to Dilute Sulphuric Acid (Ueber das Verhalten der nichtrostenden Stahle gegen verdünnte Schwefelsäure). J. FRITZ. *Krupp'sche Monatshefte*, Vol. 11, Nov. 1930, pages 267–269.

The article points out that the conclusions of some authors, who investigated the attack of dilute sulphuric acid on stainless steels as to the instability, do not correspond to the facts. GN(4)

The Influence of Contact with Other Metals on the Corrosion of Aluminum and Its Alloys. G. AKIMOW (Central Aero-Hydrodynamical Institute, Moscow). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 127–140.

Study of the electrode potentials of Al, duralumin, etc., in 3% NaCl, or 3% NaCl + H_2O_2, indicates to Akimow that pure Al, Zn, or Cd will give electrochemical protection to duralumin while Zn will protect pure Al. It is claimed that Zn will even protect duralumin in contact with Cu or with stainless (Cr) steel. The test methods are briefly described and results shown in curves. HWG(4)

Investigation of the Action of Disinfectants and Cleaning Materials on Metals. (Untersuchungen über das Verhalten der Metalle gegen Desinfektions—und Reinigungsmittel.) W. GUERTLER, T. LIEPUS, MOHR & OSTERBURG. *Metallwirtschaft*, Vol. 9, May 23, 1930, pages 447–449.

Sheet samples of 40 different metals were immersed for 24–48 hours at 45–50° C. in 24 disinfectants and cleaning solutions, included in the following 7 groups: Organic Cl preparations, organic Cl preparations with alkalies, inorganic Cl preparations, alkali mixtures, formaldehyde and similar mixtures, cresol-soap preparations and sodium phosphate mixtures. The samples were carefully cleaned, loss in weight was determined and they were examined microscopically. Iron and steel was attacked by most of the solutions, copper was not much better. Tinned steel and tinned Cu are fairly satisfactory, also tinned Cu which had been soldered. Zinc is very poor. Ni, Ni alloys, KA-2 steel and chrome plated steel were best, KA-2 steel being attacked by only 2 solutions. Al and Al alloys are attacked by all acid and alkaline solutions. Alkaline solutions containing sufficient sodium aluminate can be used for Al. CEM(4)

Selections of Rust Preventives. BERNARD JEFFS. *Black & White* (E. F. Houghton & Co.), Vol. 3, Feb. 1931, pages 17–19.

Discussion of "at least 9 fundamental properties" which must be possessed by rust preventives. MFB(4)

The Effect of Artificial Ageing upon the Resistance of Super-Duralumin to Corrosion by Sea-Water. K. L. MEISSNER (Dürener Metallwerke A. G.) *Institute of Metals, Advance Copy* No. 557, 1931, 15 pages.

Specimens of super-Duralumin (0.8 Si) that had been quenched from 500° C., and aged for 20 or 40 hrs. at temperatures up to 200° C. were exposed in the North Sea for 3 months. During exposure they were under water for 7 or 8 hrs. and in the air for 4-to-5 hr. periods. The corrosion was determined by appearance, change in weight, change in tensile properties and microscopic examination. The samples aged at 125° and 145° C. were badly pock-marked. Tensile tests indicated that these samples had been most severely attacked. Microscopic examination showed that these samples were corroding at the grain boundaries and that the pock-marks were caused by chunks of Al falling off. In such an alloy there is therefore a critical tempering range between 100° and 150° C. at which the corrosion resistance is at a minimum. This range is just below the critical hardening temperature. 6 references. JLG(4)

Corrosion-Resistant Metals and Alloys in the Dairy Equipment. C. L. MANTELL. *Food Industries*, Vol. 1, Oct. 1929, pages 585–587.

Review of the latest research work relating to materials of construction for food equipment, particularly for milk and milk products. Considers the use of Monel Metal, Ni and Ni-Cr steels. See *Metals & Alloys*, Vol. 1, Feb. 1930. page 385. (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Some Structural Characteristics of High Chromium Irons and Steels. J. H. G. MONYPENNY (Brown Bayley's Steel Works). *Metallurgia*, Vol. 1, Dec. 1929, pages 61–64; Jan. 1930, pages 115–118.

As the Cr in steel is increased the austenitic field contracts. The 12% Cr steels are susceptible to heat treatment, but, particularly in the low carbon alloys, as the Cr is increased the susceptibility to heat treatment decreases. This is due to the formation of ferrite, and if the Cr is high enough and the C low there is no phase change at any temperature in the solid alloys, and the only method of grain refinement is by working. In the high Cr steels carbides may fail to dissolve on heat treatment, and thereby decrease the quantity of Cr effective in preventing corrosion. The thermal treatment necessary to produce the desired physical and chemical properties depends on both the C and Cr concentrations. 4 references. JLG(5a)

The Metallurgical Microscope. *Metallurgist*, Feb. 1931, pages 17–18.

Begun as little more than a hobby, which gradually achieved recognition as a method of research, the microscopic examination of metals has become a recognized feature of our laboratories, both industrial and purely scientific. Although the development of other methods of investigation such as X-ray spectrometry has suggested the replacement of the microscope, yet for much investigatory work of a practical nature and for routine purposes, the microscope has come to stay. The present-day tendency is to replace visual observation with the microscope entirely by photographs. Thus microscopes are constructed for that purpose and no provision made for convenient visual observation. The eye can travel over the entire specimen and get a much better idea of the average structure than the small area represented in a photograph unless that area is chosen with painstaking skill and judgment. Insufficient observation and too hurried a recourse to photography may lead to erroneous results, the misinterpretation of the indications of structures, and may serve to discredit the value of metallurgical microscopy, more especially for practical purposes. VVK(5a)

Diffusion of Iron and Tungsten in the Solid State. (Die Diffusion von Eisen und Wolfram in festem Zustand.) K. SCHNEIDER. *Doktor-Ingenieur dissertation Tech. Hochschule*, Stuttgart, May 25, 1927, 55 pages, 9 figures, 29 micrographs, 47 references. Published by R. Noske, Borna-Leipzig.

Electrolytic Fe was heated in W powder in a H_2 atmosphere for various lengths of time ($7^1/_2$ to 72 hrs.) at 1280°, 1330° and 1400° C., layers turned off the Fe and analysis of each layer made for W. For example, heating at 1330° for 48 hours gave a surface with 10% W at the surface, the W content decreasing in a smooth curve to 3.6% at about 0.035" and from that depth it fell along another smooth curve to around 0.1% at about 0.05". The diffusion coefficients were calculated to be, in 10^{-5} cm.²/day, at 1280°, 1.9; at 1330°, 4.3; at 1400°, 1.5. Corrosion tests were made of 11 Fe-W alloys with $6^1/_2$ to 75% W, in $^1/_{10}$ N HNO_3 and 1 N H_2SO_4 and HCl. Minimum attack under the test conditions was at 41% W in HNO_3 and at 5 to 35% W in the other two acids. Tammann's "rule" of eighths was not verified. Hardness tests showed a straight-line rise from zero to $63^2/_3$% W the maximum being 129 Rockwell B, then a fall to 113 Rockwell B for W itself. From microscopic examination, hardness and corrosion tests the compound Fe_2W was indicated to exist.—H. W. Gillett (5a)-B-

The Polishing of Surfaces. J. M. MACAULAY. *Journal Royal Technical College*, Glasgow, Vol. 2, Jan. 1931, pages 378–385.

While this article deals with the polishing of glass, it is of interest in regard to metallographic polishing. The hypothesis that a polishing process may involve high local temperature, sufficient to soften the surface, and enable it to flow, was examined by polishing glass under water with a pressure of 1 lb./in.² with Pb_3O_4 for 1 hour, after which it was thought that the red lead was more yellow in color, indicating presence of PbO, which is formed on heating Pb_3O_4 to 450° C. On polishing flint glass under water for 17 hours with $CaCO_3$, the water showed traces of CaO, indicating that a temperature of around 900° C., necessary to convert the $CaCO_3$ used into CaO, must have been reached. From these experiments it is concluded that local high temperatures may exist during polishing. HWG(5a)

The Relation between the Hydrogen Overvoltage and Composition of Brass. M. DEKAY THOMPSON. *Preprint* 59–7, *American Electrochemical Society*, April 1931 meeting, 4 pages.

The hydrogen overvoltages on brass are measured for compositions varying from pure Cu to pure Zn. The points on the overvoltage-composition plot would lie nearly evenly distributed about a straight line drawn between the values for pure Cu and pure Zn, except for a decided minimum in ϵ-brass. Maxima have been found in other alloys, but this is the first sharp minimum. There is no close connection of the overvoltage with the equilibrium diagram. (5a)

The Solid Solutions of the Copper–Silver System. D. STOCKDALE (King's College, Cambridge). *Institute of Metals, Advance Copy* No. 559, 1931, 14 pages.

The solid solubility of Ag in Cu and Cu in Ag were determined by microscopic and electrical methods. The solubility of Ag in Cu is 8.2% at the eutectic temperature, 4.7% at 700° C., 0.7% at 400° C., and probably almost zero at room temperature. The solid solubility of Cu in Ag is 8.8% at the eutectic temperature, 5.8% at 700° C., 1.1% at 400° C., and about 1% at room temperature. The Cu rich solidus curves downward sharply near the limit of solid solubility. The Ag rich solidus is nearly a straight line. JLG(5a)

Explanation of the Complex Phenomena Observed during the Drawing of "Hyper-Hardened" Steels (Explication des phénoménes complexes observés pendant le revenu des aciers hypertrempés). ALBERT PORTEVIN & PIERRE CHEVENARD. *Comptes Rendus*, Vol. 191, Oct. 13, 1930, page 608–610.

In previous papers (*Comptes Rendus*, Vol. 188, 1929, page 1670; Vol. 191, 1930, pages 252 and 408) the authors have described the mechanism of the drawing of "hyper-hardened" steels (steels consisting of retained austenite) and have classified the phenomena under 3 heads:

	Reaction	Observed	Volume Change
I.	Supersaturated γ-solution → cementite → less carburized γ-solution.	During heating	Contraction
II.	γ-solution → cementite + less carburized α-solution	During heating	Expansion
III.	γ-solution → α-solution	During cooling	Big expansion: A"

In this paper, the authors discuss the first 2 reactions. During the isothermal drawing of austenite, when studied by the usual dilatometric method, an expansion or contraction is usually observed and it should be possible to connect the change in length exclusively with one or other of the reactions I and II. Further, any change in the direction of the dilatometric manifestation should show the order in which the reactions, even when they occur simultaneously, has now been confirmed by the authors who describe an improvement in technique which has enabled this to be accomplished. The results of experiments on a 1.5% C, 2.0% Cr steel are briefly described in this connection. OWE(5a)

Heat Treatment and Metallography of the Alloys of Iron and Manganese. V. N. KRIVOBOK & CYRIL WELLS. *Mining & Metallurgical Investigations, U. S. Bureau of Mines & Carnegie Institute of Technology, Mining & Metallurgical Advisory Boards*, 4th Open Meeting, Oct. 17, 1930, 4 pages.

Dividing the Fe-Mn alloys into 6 groups the micro-structure of each group is discussed individually but briefly. (5a)

Structure & X-Ray Analysis (5b)

A Practical Accessory in X-Raying Materials (Ein Praktisches Hilfsmittel bei der Durchleuchtung von Werkstücken mit Röntgenstrahlen). F. STÄBLEIN. *Krupp'sche Monatshefte*, Vol. 11, Dec. 1930, pages 316–317.

In X-raying large pieces of material, difficulties are generally encountered in covering those parts which should not be X-rayed. Since all previously suggested methods were found to be wasteful of time, the Krupp laboratories have developed, for this purpose, a mixture of plasticine with tungsten powder. GN(5b)

Preparation and Study of Bismuth Crystals. L. SCHUBNIKOW & W. J. DE HAAS. *Journal Russian Physical Society*, Vol. 62, pages 529–537 (in Russian).

Apparatus is described for production of crystals of any predetermined shape and any desired orientation of crystalline axes. The latter is achieved by placing in the apparatus a properly oriented crystalline nucleus before filling it with molten metal. Crystals form better when the main axis of the crystalline nucleus is perpendicular to the long dimension of them. When it has a parallel position the crystallization is handicapped and a strong tendency toward formation of twins can be observed. No secondary crystals were found either by a microscope or by using X-rays where no rings were observed, only spots. No coating with polycrystalline layer was found. Electric conductivity studies showed that no intercrystalline fractures were formed up to the load of 300 g./mm.^{2} (5b)

X-Rays and Metallurgy. L. PICKUP. *Metallurgia*, Vol. 3, Jan. 1931, pages 101–103, 108.

Mention is made of radiography and methods for studying crystal structure are described. Lists the crystal structures of the common metals. JLG(5b)

Twinning in Metals. C. H. MATHEWSON (Yale University). *Transactions, American Institute of Mining and Metallurgical Engineers*, Vol. 76, 1928, pages 554–601; *Proceedings Institute of Metals Division*, 1928, pages 7–54.

Lecture at New York meeting, Feb. 1928. A comprehensive discussion of twinning in metals. Twinning is common in face-centered cubic and hexagonal metals. There is some question whether or not twinning occurs in body-centered cubic metals, but Neumanns in α-iron are probably twins. Twinning is common in some of the metals of lower symmetry. Experimental work that illustrated the mechanism of twinning in zinc is reported in detail. Twinning in brass and iron is described in less detail. 50 references. JLG(5b)

Lattice Distortions as a Factor in the Hardening of Metals. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Oct. 1930, page 781.

A critical abstract of a paper by the same name by W. L. Fink & K. R. Van Horn before the Institute of Metals, Oct. 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. ESC(5b)

New Applications for the X-Ray Are Continuously Being Discovered. DON. S. BROWN. *Electric Journal*, Vol. 28, Feb. 1931, pages 88–90.

A review indicating the applications of the X-ray to the medical, therapeutic industrial fields, arts and sciences, X-rays have been used to detect flaws and blow holes in castings, to inspect welds and insulated electric conductors; to check the workmanship of complex mechanical assemblies such as shells; to detect impurities in sugar and flour to determine the amount of ash in coal and the proportion of fat to lean in canned beef, etc. WHB(5b)

The Crystal Structure of the Compound Fe_2B (Kristallbau der Verbindung Fe_2B). GUNNAR HÄGG. *Zeitschrift für Physikalishe Chemie*, Part 2, Vol. 11, Dec. 1930, pages 152–162.

Fe_2B crystallizes on a tetragonal body-centered lattice with 4 molecules within the unit cell. The coordinates of the positions of the iron atoms are as follows:

$$m, m, p; \quad m + 1/2, \underline{m + 1/2}, p + 1/2 \qquad m, \overline{m}, p; \quad m + 1/2, \underline{1/2 - m}, p + 1/2$$

$$\underline{m, m, p}; \quad 1/2 - m, 1/2 - m, p + 1/2; \qquad \underline{m, m, p}; \quad 1/2 - m, m + 1/2, 1/2 - p.$$

The parameters are $m = 1/6$ and $p = 1/4$. The boron atoms occupy points having the following coordinates:

$$1/2\ 0\ 0;\ 1/2\ 0\ 1/2;\ 0\ 1/2\ 0;\ 0\ 1/2\ 1/2$$ OWE(5b)

Crystal Structure of the Alloys of Iron and Manganese. JAMES B. FRIAUF & MAXELL GENSAMER. *Mining & Metallurgical Investigations U. S. Bureau of Mines & Carnegie Institute of Technology, Mining & Metallurgical Advisory Boards, 4th Open Meeting*, Oct. 17, 1930, 6 pages.

On X-ray analyses α-Fe is present in Fe-Mn alloys up to at least 16% Mn. γ-Fe makes its appearance at room temperature in the forged alloys with 13% Mn. Another phase, the hexagonal close packed arrangement, was found in forged alloys containing 10–26% Mn. (5b)

Solubility of Carbide in Ferrite. H. A. DICKIE. *Fuels & Furnaces*, Vol. 8, May 1930, pages 653–654, 682.

From a paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 340. MS(5b)

X-ray Studies of the Aging Problem. I. (Röntgenographische Studien zum Vergütungsproblem. I.) E. SCHMID & G. WASSERMANN. *Mitteilungen der deutsche Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 41–46; *Metallwirtschaft*, Vol. 9, 1930, page 421.

This deals with duralumin (German specification 681 B) aged at room temperature, with and without cold working immediately after quenching. On aging, the lattice constant first shows a very small contraction, taking place through the "induction period" of the increase in hardness, but thereafter shows practically no change. Lattice distortion was not observed during room temperature aging; there was no widening or increase in fuzziness of the Kα doublet. However, widening and fuzziness of the lines occurs upon deformation of the hardenable Al alloys, and it is conjectured that this phenomenon is connected with the presence of a supersaturated solid solution. HWG(5b)

Investigation of the Make-Up of Metallic Systems by X-Rays. (Untersuchung über den Aufbau metallischer Systeme mittels Röntgenstrahlen.) A. WESTGREN (University of Stockholm). *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 368–373. 12 references.

X-ray examination can no longer be dispensed with in modern metallurgical research laboratories according to Westgren who aims at an early adoption of this testing method in scientific metallurgy. By a set of clear, typical photograms (powder-method) of Ag-Cd alloys, α-bronze, carbide phases of various steels and γ-brass phases, the author demonstrates the potentialities of X-ray photography. The border lines of ranges of homogeneity in constitutional diagrams can safely be established by means of space lattice measurements, and the various phases of a system can reliably be identified by the X-ray method. The classification of intermetallic phases based on their crystal structure yielded a relationship between the formation of certain types of atomic arrangements in alloys and their properties or the concentration of quanti-valence electrons. The same laws regarding the formation of the β- and γ-phases in Cu, Ag and Au alloys seem to hold true as well for the alloys of the transition elements. EF(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Wire Ropes and Wires for Rope. (Drahtseile und Seildrähte.) A. PAULI (Swiss Railways). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 141–148, 9 references.

Discusses the incompleteness of present knowledge and of testing methods in this field. HWG(6)

Fatique Strength of Welded Steel Joints (Dauerfestigkeit geschweisster Stahlverbindungen). W. HOFFMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 15, 1930, pages 1561–1564; *Autogene Metallbearbeitung*, Vol. 24, Apr. 1, 1931, pages 99–102.

Oxy-acetylene welded steel pipes of different compositions and the electrically welded German steels, St 37, St 48 and St 52, are examined with regard to their physical and dynamic strength. From the test results which are produced in detail with microphotographs, it can be concluded that the welded pipe joints had an average strength of 50% of the material. Care must be taken that the local heat development during welding does not become too high and that it has a uniform distribution throughout the whole piece. The seam must not be too wide but, especially, not too high since this influences the permanent strength. Easy weldability (fusibility) of the material of the piece and of the added material is essential. The permanent strength of electric arc welds depends greatly upon the electrode material (added material). The latter should give absolutely forgeable welds. The burning depths should be as great as possible and have the proper proportion to the piece and its heating. The seam should show a smooth surface. Impact fatigue strength and vibration strength are very likely to be higher than in riveted joints. 7 references. Ha(6)

Structure Changes in Duralumin during Tensile Testing. E. F. BACHMETEW. *Transactions of the Central Aero-Hydrodynamical Institute*, No. 71 (in Russian), 36 pages.

Changes taking place during the deformation of duralumin in a tensile machine were studied. Duralumin sheets 2.5 mm. thick in annealed, quenched and aged, and quenched state were used as specimens. Polished and etched specimens were loaded in an Amsler machine for about one minute with a given load, permanent deformation determined and the structure photographed. The cycles were repeated on the same specimens but with increasing loads until the failure occurred. The type of heat treatment has no effect on the character of crystalline changes. With low stresses a certain amount of deformation of individual crystalline units was observed with some shifting of relative positions and rotation but without any appreciable modifications within the body of units. With the increasing loads a certain darkening of some areas of the surface caused by its bulging was observed which was followed on further loading by the appearance of slippage lines. They originated within the grains growing gradually to the periphery, always being parallel to each other in any given grain. At the latest stages of deformation a second set of slippage lines appeared being almost symmetrical with the direction of deformation and crossing the former pattern. No twinning was observed. (6)

Fatigue and Impact Testing of Welded Products. T. M. JASPER (A. O. Smith Corporation). *Preprint, American Society for Testing Materials*, Mar. 1931, 7 pages.

Fatigue testing is useful for selection of types of steel for engineering use, and in study of welding methods, but it is a slow research method, not suitable for routine testing. Impact testing may not closely represent the service conditions, but will differentiate a brittle weld from a tough one. The most practical test for welded pressure vessels in a severe hydraulic pressure test. HWG(6)

Testing Mine Cables. (Die Prüfung der Hebeseile für Bergwerke.) A. N. DINNIK (Russian Berginstitut). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 149–155, 1 figure.

In Russia the strength of a cable is calculated from the strength of the wires that make it up. This is not adequate; the cable itself should be tested. HWG(6)

Fatigue Tests on Iron and Steel. (Utmattningsprov pa Järn och Stal.) AXEL LUNDGREN. *Jernkontorets Annaler*, Vol. 115, Jan. 15, 1931, pages 1–70.

Besides a detailed review of the most important results obtained in different countries by studies on the fatigue of metals, a report is given on investigations carried out at the Government Testing Institute, Stockholm. The results of these investigations, which were made with the "Alpha" testing machine may be summarized as follows. Test bars for one-sided load were made with 0, 1, 2, 5 and 10 mm. fillet radii. A radius of 10 mm. gave 90% higher fatigue limit than a radius of 0 mm. and 2% higher than a radius of 5 mm. Tests with constant moment gave a 2–3% higher fatigue limit than tests with one-sided load. The number of steels were investigated with the object of studying the relation between endurance and heat treatment as well as between endurance and other mechanical properties. Widely differing annealing temperatures were found to have a very slight influence on the fatigue limit. On the other hand, the endurance is considerably increased by quenching and varies with the degree of tempering. No marked relation was found between the fatigue limit and the limit of proportionality or the yield point. The relation between endurance and ultimate stress is more pronounced. A scrutiny of the results of this and previous investigations indciated, that the ratio K of fatigue limit to ultimate stress varies within certain limits and increases with reduction of area. By plotting K against reduction, diagrams were obtained for steels with different micro-structure, from which the following conclusions may be drawn. *Pearlitic carbon steels.* K = 0.37 for a reduction of area less than 36%. Above this value K increases with reduction. *Pearlitic Ni and Cr steels.* Higher values of K than in pearlitic carbon steels. *Sorbitic steels.* Considerably higher values of K than in pearlitic steels. Increase of K with reduction of area not so pronounced as in pearlitic steels. *Steels containing a mixture of sorbite, pearlite and ferrite, with the ferrite in the form of network.* K considerably lower than in sorbitic steels, sometimes even lower than in sorbitic steels, sometimes even lower than in pearlitic. *Martensitic-troostitic steels with high ultimate stress.* Lower values of K than in sorbitic steels. A one page English summary is given. 43 references. HCD(6)

The Effect of Surface Condition on Fatigue Tests Results. C. H. M. JENKINS (National Physical Laboratory, England). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 145–148, 15 references.

Discrepancies between laboratory fatigue tests and service performance under repeated stress may be due to differences in actual stress from presence of sharp corners, notches, scratches, etc., to differences in the surface, due to decarburization, surface cracks from machining or quenching, or to internal stresses, when these factors are removed in the preparation of the laboratory specimen, or else due to corrosion or other alteration of the surface in practice. HWG(6)

Comparison of Results of Tests in Tension, Torsion and Bending. G. COOK (King's College, London). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 26–30, 10 references.

The elastic limit is not reached at the same stress in tension, torsion and bending, which is not explained by present theories. A metastable state at the elastic limit is suggested for mild steel. HWG(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Some Properties of Protective Films on Metals. ERNEST S. HEDGES. *Chemistry & Industry*, Vol. 50, Jan. 9, 1931, pages 21–25.

A review of film properties with special consideration of the work carried out by Evans and the author. A theory of anodic polarization is offered, according to which OH ions are discharged simultaneously with other anions, such as SO_4 ions for instance, if a certain critical current density is reached and more SO_4 ions are discharged than can be replaced. This has the effect of producing a layer of oxide or basic salt on the surface. The presence of SO_4 ions renders this film non-protective, but it has the effect of raising very greatly the effective current density at those areas of the electrode which are uncovered. The consequence will be that in some spots the discharge will consist of OH ions only, which give a perfectly continuous oxide film. The discontinuous film first formed will be thrown off the electrode by the subsequent evolution of O_2. (7a)

The Effects of Acids and Alkalies on the pH of Nickel Baths. W. LOCKERBIE. *Brass World*, Vol. 26, July 1930, page 175.

An abstract of a study of the effects of different acids and alkalis on nickel baths using the Sizelove method of titration with methyl red. WHB(7a)

Unsolved Problems in Chromium Plating. W. BLUM. *Monthly Review, American Electroplaters Society*, Vol. 18, Feb. 1931, pages 4–6.

References particularly made to researches in progress at the Bureau of Standards on: theory of chromium plating; hardness and wear resistance; protective value against corrosion. MFB (7a)

The Deposition of Nickel at a Low pH. H. C. MOUGEY & W. M. PHILLIPS (General Motors Corporation). *Brass World*, Vol. 26, July 1930, pages 159–61.

The authors experimented with a Watts' nickel solution at pH's from 60 down to 1 at varying temperatures and current densities. There appears to be two ranges of pH, from 5.5–6.0 and from 1–2, where satisfactory results are obtained. At the lower pH range, operating at 35–40 amperes/ft.^{2} and 120° F. with 8 oz. of metal per gallon. A very rapid gain in the rate of deposition, better anode corrosion, complete maintenance of metal in the solution from the anode, relatively no pitting after the solution has been operated for some time and deposits of very satisfactory character are claimed. The cathode efficiency approximates 70%. As the temperature varies, the appropriate current density must be varied. WHB(7a)

High Speed Nickel Plating as Practiced in England. ERNEST R. CANNING. *Preprint* 59–9, *American Electrochemical Society*, April 1931 Meeting, 4 pages.

In England current densities of 2.2 amp./dm.^{2} and over are used. Continuous filtrations of the electrolyte, kept at 32–35° C., is necessary to eliminate suspended foreign matter and pinholes. Due to considerable loss in throwing power, the author advises against very high current densities. The preferred pH is 5.6–5.8. The cathode efficiency is 96–97%. A plate 0.001 in. (0.025 mm.) thick is obtained in 45 minutes, with a variation in thickness of not more than 45%. For adequate protection of the steel, a nickel plate of at least 0.001 in. is necessary. For sub-tropical countries composite deposits of Ni-Cu-Ni are recommended. (7a)

Electrometallurgy (7b)

Rapid Estimation of Current Efficiency in Zinc Electrolysis. *Canadian Chemistry & Metallurgy*, Vol. 15, Mar. 1931, page 77.

The staff of the Consolidated Mining & Smelting Co. of Canada, Ltd., has developed an apparatus that will reliably index the solution quality within 45 minutes. The apparatus is based on the principle that if Zn is deposited from an electrolyte free of toxic impurities, using a peroxidized Pb anode and a Zn cathode, no evolution of hydrogen occurs from the cathode and the current efficiency of Zn deposition approximates 100%. Sb, As, Co and other metals tend to lower the hydrogen overvoltage at the cathode, with liberation of some hydrogen concurrently with the deposition of Zn. The apparatus consists of a glass cell (an inverted 5-lb. reagent bottle with mouth stoppered and bottom removed) containing two lead anodes and an aluminum cathode with a diaphragm between (wood battery separators). A collecting bell attached to a gas burette is assembled over the cathode. The electrical equipment consists of a 12 volt battery or ammeter and a rheostat to control current through the cell. After electrolyzing the solution under standard plant conditions for a definite period solution is drawn up into the collecting apparatus—electrolysis continuing for a definite period. Hydrogen liberated, measured by displacement, is reduced to standard conditions of temperature, and pressure, and the current efficiency for hydrogen liberation deducted from 100 is the current efficiency for Zn deposition. WHB(7b)

Operating Data on Electrolytic Metal Production and Refining. C. L. MANTELL. *Engineering & Mining Journal*, Vol. 131, Mar. 23, 1931, pages 256–259.

Operating data from the electrolytic plants of the U. S. and Canada show the composition of electrolytes, equipment, methods of applying the current and efficiency obtained from the power, raw materials used and by-products produced. The tables cover the electrolytic refining of Cu and electrolysis of Cu-bearing solutions obtained by leaching processes, production of Zn, Cd, Pb, Ni, Sn, Ag and Au. The high power cost of processes using insoluble anodes is indicated in the tables. The diaphragm used in Ni production causes an increase in cell voltage with attendant high power costs. WHB(7b)

Process for Making Electrolytic Zinc. *South African Mining & Engineering Journal*, Vol. 41, July 19, 1930, page 591.

Brief descriptions are given of the Anaconda and Tainton processes for making electrolytic zinc. AHE(7b)

Electrolytic Copper Refining at Mount Lyell, Tasmania. WILLIAM HART. *Engineering & Mining Journal*, Vol. 131, Jan. 12, 1931, pages 3–7.

The refinery at Queenstown, Tasmania, has been in operation for 2½ years. A plan, photos and sections of the electrolytic refinery are shown and the operations outlined. The method of starting operations is interesting and probably unique, because no attempt is made to heat the electrolyte, the current being turned on when the solution is cold. The addition of 44 cells will increase the capacity to 13,000 long tons per annum. WHB(7b)

Recent Advances in Technical Electrolysis. (Neuere Fortschritte der Technischen Electrolyse.) J. BILLITER. *Chemiker-Zeitung*, Vol. 54, Mar. 12, 1930, *Fortschrittsberichte*, pages 7–13.

Contains 10 references. A review of the 1929 progress in the electrolysis of Cu, Zn, Fe, also Cd and Sn, the production of finished products, such as sheets and tubes, the electrolytic decomposition of water, the purification of water, production of alkali chlorides, the electrolytic production of Be, Na and Al, and the outlook for the future. CEM(7b)

Electrothermic Zinc. G. NEWTON KIRSEBOM. *Engineering & Mining Journal*, Vol. 131, Jan. 26, 1931, page 55.

A brief review. WHB(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Advantages and Disadvantages of Different Types of Hot Galvanizing Furnaces. W. G. IMHOFF. *Wire & Wire Products*, Vol. 6, Feb. 1931, pages 50–52, 72–74.

The article considers the different types of galvanizing furnaces for various purposes, the fuels for heating the galvanizing pots, the destruction of kettles through corrosion attack, in particular at temperatures above 500° C., the principles of galvanizing and the control of the process. GN(8)

Northern Electric Adopts Electric Heat for Sherardizing. F. R. BARNSLEY. *Iron & Steel of Canada*, Vol. 13, Dec. 1931, pages 278–286.

Author discusses the 3 general methods of applying zinc coatings to steel and then describes the first electric sherardizing furnace to be installed in Canada. A typical operating cycle is as follows:

Charge 1600 lbs. of castings.
Zinc dust 560 lbs.
Temperature 720° F.
Radiation loss at 710° F.—9.5 kw-hrs. per hour.
Time of cycle—6½ hrs.
Thickness of deposit—0.0025 in. OWE(8)

Heat Insulation Cuts Energy Required for Electric Galvanizing. WALLACE G. IMHOFF. *Electrical World*, Vol. 97, Feb. 28, 1931, page 415.

Proper insulation around the sides, bottom and top of the kettle results in a saving in heat loss of about 36% and increase in efficiency from 14 to approximately 50%. A chart shows that more than half the radiation losses in galvanizing pots takes place at the surface of the metal. The advantages of electric galvanizing include: uniform temperature control, with attendant reduction of dross, uniform and economical zinc coating, increased pot life and better quality with less rejects. Also saving in labor and elimination of products of combustion and lowering of room temperature and favorable overhead costs. Tables and curves show the power consumption and how the saving in energy may be effected through the proper heat insulation of the kettles. WHB(8)

Some Practical Aspects of the Hot Galvanizing Industry. W. G. IMHOFF. *Iron & Steel of Canada*, Vol. 13, Nov. 1930, pages 250–259.

This article discusses the hot galvanizing process. It deals first with the quantity of zinc-coated materials produced in the United States. The various methods of galvanizing are then considered, as is also the production of sal-ammoniac skimmings, zinc ashes, and dross, the proportions of these materials obtained in various industries being considered in some detail. The microstructure of dross crystals is dealt with, and some explanation of the differences in the quantities of dross made in the various branches of the galvanizing industry is offered. OWE(8)

Some Observations on the Thickness of Hot-Dipped Zinc Coatings as Actually Measured with Micrometer Calipers. WALLACE G. IMHOFF. *American Metal Market*, Vol. 37, Nov. 22, 1930, pages 5, 10.

The thickness of the coating was measured by micrometer readings and checked by calculating the thickness from the known area and the total weight of Zn deposited. The tests were made on galvanized Fe water pails and the results are tabulated. Measured thickness on different samples averaged 0.0041–0.0045 in. and the calculated, 0.0024–0.0030, indicating an alloy bond of 0.0013–0.0017 in. WHB(8)

Galvanizing Prevents Metallic Decomposition. W. H. SPOWERS. *Wire & Wire Products*, Vol. 5, July 1930, pages 268–269, 289–290; Aug. 1930, pages 308–309, 326.

The protective action of zinc coatings is described and the use of zinc chloride as a flux in galvanizing and the formation of dross are discussed. The elimination of zinc oxide in the galvanizing kettle and the structure of zinc coatings are dealt with. GN(8)

INDUSTRIAL USES & APPLICATIONS (9)

Tube Materials for High-Pressure Water-Tube Boilers. S. F. DOREY. *Metallurgia*, Vol. 3, Nov. 1930, pages 31–34; *Engineer*, Vol. 150, Nov. 21, 1930, pages 566–568; Nov. 28, 1930, pages 588–589.

Extract from a paper presented before the Institute of Marine Engineers, Nov. 11, 1930. JLG(9)

Aluminum in the Chemical Industry. H. V. CHURCHILL. *Industrial & Engineering Chemistry*, Vol. 22, Sept. 1930, pages 993–995.

The article draws attention to some uses of Al and its alloys based on corrosion resistance, and on the improvement in quality of product. Acetic acid manufacture employs Al metal; other organic acids and neutral products are manufactured or stored in Al ware. Where alkaline solutions are handled, Al metal is out of the question. The effect of high temperature is briefly discussed, as well as thermal conductivity and the importance of considering the position of Al in the electromotive series when designing Al equipment. Al paint and Al foil find considerable use as good heat reflectors and protective coatings. MEH(9)

Advantages of Lightening Transportation Means in General. What Solution Aluminum and Its Alloys Might Bring to the Problem. (Interet de l'allegement des moyensde transport en general. Quelle solution l'aluminium et ses alliages apportent a ce probleme.) A. DE BIRAN. *Revue de Metallurgie*, Vol. 27, Dec. 1930, pages 633–653.

Points out the disadvantages of disproportional relation between the carrying capacity and the weight of different transportation means. Many formulae are given to support the point and to demonstrate that the reduction of the dead weight can be advantageously achieved using light metals. JDG(9)

Roller Bearings for Locomotives and Cars. T. V. BUCKWALTER. *Railway Mechanical Engineer*, Vol. 105, Feb. 1931, pages 74–76.

A summary of questions and answers bearing upon design, operation and future possibilities of roller bearings in the railway field. GN(9)

The Manufacture of S. A. A. Cartridge Cases. F. ADCOCK. *Engineer*, Vol. 150, Dec. 19, 1930, pages 668–669; Dec. 26, 1930, pages 700–702.

Following is typical specification of cartridge case metal: Cu 69–70%, any single impurity not over 0.25%, total impurities not over 0.50% and remainder Zn. Details are given of producing accurate strip; blanking and cupping process; method of making cupping dies, including design of dies; and of final operations consisting of drawing, indenting, heading, and tapering. Article is well illustrated with diagrams. LFM(9)

Traveling Crane Is Built of Aluminum. F. V. & E. C. HARTMANN. *Iron Trade Review*, Vol. 86, Feb. 6, 1930, pages 82–83.

See *Metals & Alloys*, Vol. 1, July 1930, page 630. MS(9)

Steel House Construction. LEE H. MILLER. *Yearbook American Iron & Steel Institute*, 1930, pages 148–172, includes discussion; *Metal Stampings*, Vol. 3, June 1930, pages 539–540; *Rolling Mill Journal*, Vol. 4, May 1930, pages 211–212.

A paper read before the *American Iron & Steel Institute*. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. MS(9)

Fabricates Road Building Units by Arc Welding Process. *Iron Trade Review*, Vol. 86, May 8, 1930, pages 60–61.

Brief description and illustrations of dump trucks, snow-plow, crushing and screening plant, and cement mixer employing arc-welded steel construction. MS(9)

The Use of Corrosion Resistant Steel in the Manufacture of Nitric Acid. (L'impiego degli acciai inossidabili nella fabbricazione dell'acido nitrico.) G. ALLEGRO. *La Metallurgia Italiana*, Vol. 23, Feb. 1931, pages 106–108.

Description and 4 photos of application of 0.10% C, 18% Cr, 6% Ni steel in nitric acid manufacture. HWG(9)

Wear Tolerances on Gages. Discussion of E. J. Bryant's Production Meeting Paper. JOHN GAILLARD. *S. A. E. Journal*, Vol. 28, Feb. 1931, pages 210–214.

Included in the paper are recommendations for establishing wear tolerances as well as manufacturing tolerances for gages and definite periods for checking gages in service. Disposal of the manufacturing tolerance was discussed, and tables of tolerances recommended by the A.E.S.C. were presented. A study of effect of gage wear and methods of inspecting gages, presented by A. W. Shoof, leads discussion. Sharp disagreement with basis of the A.E.S.C. system of tolerances is expressed by representatives of leading auto manufacturers, and a tabulation of tolerances is presented, based on standard reamer sizes adopted by both General Motors and Chrysler manufacturing units. Warning is given by W. J. Gourlie, a gage manufacturer, against dangers that gage tolerances may either increase cost of producing work, because of making manufacturing tolerances smaller than intended, or allow work outside specified tolerances. A parts manufacturer called attention to gaging problems arising from distortion of work after measuring, because of releasing casting, forging or chucking strains. Author sees need of two classes of limit, one based upon standard shafts and one upon standard holes. He emphasizes the fact that gages and tools are not an end but a means to an end. For abstract of paper also see *Metals & Alloys*, Vol. 2, Feb. 1931, page 39. MFB(9)

Materials at High Temperatures, Special Alloys of Iron, Nickel and Chromium. R. HADFIELD (England). *First Communications of the New International Association for the Testing of Materials.* Group A, Zurich, 1930, pages 104–110.

Brief account of some commercial applications of these alloys. HWG(9)

Design and Manufacture of Special Steel Castings for Rolling Stock. H. R. BARTELL. *Canadian Foundryman*, Vol. 22, Feb. 1931, page 18.

Report of paper given before the Canadian Railway Club, Montreal. Refers to strides made as result of the use of cast steel in the manufacture of railroad equipment. OWE(9)

Results Obtained with Aluminum in Construction of Street Cars and Railway Coaches. (Resultados obtenidos con el alumino en la construction de tranvias y coches de ferrocarril.) P. M. HAENNI (Aluminum Ltd., Geneva). *Revista Minera, Metalurgica y de ingenieria*, Vol. 81, Dec. 8, 1930, pages 542, 544; Vol. 81, Dec. 24, 1930, pages 566–568; Vol. 82, Jan. 8, 1931, pages 14–16; *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 12–18.

Paper before Int. Congress of Mining and Metallurgy, Liege, June 1930. Properties and applications in railway use or cold worked and heat-treated aluminum alloys. The average weight saving in street cars is 30% if full use is made of aluminum alloys. After brief comment on the necessary precautions as to subjection of heat treatable aluminum alloys to too high a temperature it is pointed out that, for railway uses, welding should be avoided as far as possible, in favor of riveting, castings should be used as little as possible, contact with heavy metals should be avoided to prevent electrolytic attack, the dimensions of parts should be 30 to 50% greater than with steel, the metal should be painted or otherwise protected, compression members should be designed to avoid flexure, with due regard to the low modulus, and in general, fillets should be more generous than with steel. The lower modulus, tensile strength and high coefficient of expansion should be allowed for in design. The disadvantages are more than compensated by the weight saving possible. A list is given of some 30 American, 6 French, 4 German, 3 Italian, 2 English, and 1 Swiss companies which are using some light alloys, mostly of the duralumin type, in street and railway cars. Two Italian companies are listed as using some magnesium alloys. The average percentage lightening of the cars used by ten companies is 33% and the diminution in energy consumed, 28%. Maintenance costs are reduced, due to better corrosion resistance of aluminum than steel. Noise is diminished. Scrap value is large. Calculation of net cost savings is made. The experimental epoch has passed, and many roads are standardizing on aluminum. HWG + EF(9)

The Application of Copper to the Building Trade. JULIUS FRITH. *Metal Industry*, London, Vol. 38, March 6, 1931, pages 265–266.

Paper read before the Institute of Metals, Swansea Local Section, Feb. 10, 1931. Compares Cu with Pb and Fe for water pipes. The quantity of Cu dissolved by most drinking water in 24 hours seldom exceeds 0.04 part in 100,000 while safe limit is 0.14 part in 100,000. The wall thickness of Cu tubes may be reduced by using one of the various types of compression joints now available. Cu tubes are strong, stiff, light in weight, and resist freezing conditions well. It is best not to have different metals in one installation on account of corrosion difficulties. Cu roofing is advantageous because of permanence, high melting point in case of fire, and relatively low cost. Cu and its alloys are being used for doors, window frames, and shop fronts. PRK(9)

The Use of Elektron Metal in Airplane Construction. E. I. DE RIDDER. *Technical Memorandum National Advisory Committee for Aeronautics*, No. 608, Washington, Feb. 1931, mimeographed, 22 pages, 49 figures. Translated by J. Vanier from 1929 *Jahrbuch der Wissenschaftlichen Gesellschaft für Luftfahrt.*

The elektron alloys discussed are described by trade symbols, like A Z F, A Z M, A M 503, V I, etc., the chemical composition not being given. The corrodibility of magnesium alloys is admitted, but they are, nevertheless, claimed to be usable in aircraft service. Pickling in nitric-acid-chromate solution to produce a corrosion resistant surface, and varnishing are recommended. A row boat of elektron is shown which is said to be in good shape after 2 years use without revarnishing. Satisfactory use is claimed in wing ribs, fuel tanks, fittings, crank cases, carburetor manifolds, engine cowling and propeller fairing, wheels, shock absorber legs, and tail skids. Elektron sheet wing covering is classed as experimental only. One cast alloy is especially recommended for service involving high temporary stress as in landing gear and tail skids. Another is suggested for fatigue resistance and its endurance limit is said to be around 10,000 lbs./in.^{2} Chairs made from elektron were 23% lighter, 10% stronger, and the manufacturing cost was 450% compared to duralumin. It is claimed that by using elektron to the maximum the saving in empty weight is about 15%, corresponding to an increase in pay load of 40 to 70%. For example, it is calculated that a 13-passenger Junkers plane, using elektron, could carry 21 passengers. Recommendations are made for methods of welding, hot-working (at 270–330° C.), bending, riveting etc. Comparisons of merit on the basis of yield point, tensile strength, endurance limit are made with duralumin and iron. The sizes in which commercial elektron alloys are available and their various static and dynamic physical properties are stated. HWG(9)

HEAT TREATMENT (10)

Heat Treatment of Low Carbon Steel. WELTON J. CROOK. *Metal Progress*, Vol. 1, Oct. 1930, pages 47–52.

It has been found that certain steels of around 0.20% C can be materially improved in physical properties by quenching from 1600 to 1650° F. The presence of at least 0.50% Mn, and a practically complete state of deoxidation are apparently necessary conditions. (U. S. Pat. No. 1,592,181, W. J. Crook) Steels of this type are said to "regenerate" if quenching from just above the Ac_3 point results in the complete solution of the ferrite and the formation of low C martensite of 500 Brinell or over. While fully hardened low C steels have but little practical application, drawing to various temperatures after proper quenching gives a range of physical properties often superior to those of ordinary heat treated alloy steels for structural purposes. In one series of tests 2" × 1/2" flats 30" long analyzing 0.14% C and 0.58% Mn, were water quenched from 1600° F. and drawn at 1000° F. for 30 min., resulting in an increase in Y. P. from 40,200 to 65,500 without falling below a minimum of 20% elongation in 8". WHK(10)

Furnaces for Heat Treatment of High-Duty Bearing Balls. R. E. COWARD. *Wire & Wire Products*, Vol. 6, Feb. 1931, pages 53–54, 70–71.

The article describes composition, forming, hardening, quenching and tempering of ball steel with special reference to the various furnaces used. The advantages of rotary furnaces are outlined. Stationary furnaces are used for large balls. Quenching furnaces and oil baths for tempering are considered. GN(10)

Manufacture and Heat Treatment of Wrenches. J. E. HART (Walworth Company). *Fuels & Furnaces*, Vol. 8, Apr. 1930, pages 465–470, 493–494.

Bars and jaws of Stillson wrenches are drop forged from basic open-hearth steel containing 0.8% C. See *Metals & Alloys*, Vol. 1, July 1929, page 25. MS(10)

Selection and Heat Treatment of Ball Roller Bearing Steels. ERNEST F. DAVIS. *Fuels & Furnaces*, Vol. 9, Feb. 1931, pages 153–162.

Ball steels contain 1% C and 0.75–1.65% Cr, depending upon ball diameter. Smaller sizes have lower Cr content. Failures of balls in service result from surface defects, surface decarburization, excessive carbide segregation, and the commoner defects such as inclusions and center segregation. Steels for races are the high-C-Cr steel and the carburized grades such as the Ni-Mo, and the 3 1/2% Ni. Most widely used steel for carburized races is SAE 4615. Roll steels are the high-C-Cr steel, spring steel of modified SAE 4150 analysis and the carburized grades. Gives analyses of the various steels and outlines methods of heat treatment. MS(10)

Wider Use of Heat Treatment for Gray Iron Castings. H. BORNSTEIN (Deere & Co.). *Iron Age*, Vol. 126, Sept. 11, 1930, pages 688–690, 756–757.

Commercial development of heat treatment of cast Fe has been along the lines of machinability and removing internal stresses. Three classes of heat treatments used are: (1) Artificial aging; (2) Annealing; (3) Quenching. Cast Fe pistons used in automobiles are heat treated to remove internal stresses. The heating range between 900° and 1100° F. will eliminate internal stresses without causing any structural changes in the metal. Annealing temperature employed ranges from 1200–1600° F. Desirable method of heat treatment is to heat and cool slowly. Two types of furnaces used. Results of annealing regular and alloy casting:

Chemical Analysis	Regular Fe %	Alloy Fe %
Silicon	2.07	2.11
Sulphur	0.087	0.078
Phosphorus	0.16	0.17
Manganese	0.72	0.68
Total carbon	3.38	3.34
Chromium		0.25
Nickel		0.62
Transverse test 1.20 in. arbitration test bar:		
Breaking test, lbs.	2, 480	2, 730
Deflection, in.	0.29	0.28
Tensile Tests:		
Ultimate strength, lbs./in.^{2}	35,320	38,580
Brinell Hardness	217	228

VSP(10)

Heat Treatment of High-Duty Bearing Balls. R. E. COWARD. *Iron & Steel of Canada*, Vol. 14, Jan. 1931, pages 3–16.

Description of methods employed in production of high-duty bearing balls made of steel containing approximately 1% C and from 0.50 to 1.50% Cr. Methods of forming the balls, methods of heat treatment, and types of furnaces used in heat treatment are discussed. OWE(10)

Influence of Furnace Atmosphere on Correct Heat Treatment. E. W. ESSLINGER. *Metal Progress*, Vol. 1, Oct. 1930, pages 60–63.

A general discussion of the problem. WHK(10)

Advances and Trend in Heat Treating Aluminum Alloys. ROBERT J. ANDERSON. *Iron Age*, Vol. 126, Sept. 11, 1930, pages 696–698.

Metallography of Al has only been developed since 1920. Heat treated Al alloys are displacing old and previously well established materials in many engineering applications. Special compositions have been developed for particular purposes. Alloys of Al-Mg silicide type for high tension electric cables and alloy called "aldrey" used for power transmission in Europe are of recent development. Trend toward the use of electric furnaces and ovens in the Al industry is definite. Heat treated Al alloys have found the most usefulness and greatest variety of applications in the fields of modern transport—land, water and air. There is a large field for the use of heat-treated Al alloys in building of machinery and machine tools, both in case of moving parts and dead-weight components. VSP(10)

Decarburization of Steels in Molten Barium Chloride Baths. ALBERT PORTEVIN & VICTOR BERNARD. *Chimie & Industrie*, Special Number, Vol. 23, Mar. 1930, pages 243–244.

Molten $BaCl_2$ baths used to heat high-speed tool steels to 1250° C. prior to quenching cause a marked decarburization of the steel, the degree of which increases with the time of immersion, the temperature of the bath and the age of the bath. Addition of charcoal and of cyanamide did not reduce the decarburization. (10)

Hardening and Tempering, Heat Treatment Practice. (Härten und Vergüten, Die Praxis der Warmbehandlung.) E. SIMON. Julius Springer Verlag, Berlin, 1931. Paper, 6 × 9 inches, 65 pages, 116 figs. Price 2 RM.

This is a copiously illustrated, practical handbook, which is evidently popular in Germany, 18,000 copies of earlier editions having been distributed.

Many types of furnaces for hardening, tempering and carburizing are shown, and the uses of each briefly described. Few continuous furnaces are dealt with, chief consideration being given to small batch-type furnaces. Pyrometric control is very sketchily dealt with, and automatic temperature control is not considered.

Shop kinks are given for quenching with minimum distortion, and for local hardening, with sketches of the apparatus and tools used.

The pamphlet would be useful in shops doing small scale batch heat-treatment, but is far from being up-to-date as regards modern production practice in automobile plants, for example.

It is written from the practical point of view, and does not deal with metallurgical phases of heat-treatment. There is a table of contents, but no adequate index.—H. W. Gillett. (10)-B-

Hardening (10a)

Oil Hardening and Air Hardening Cast Iron. J. E. Hurst. *Iron & Steel Industry & British Foundryman*, Vol. 4, Dec. 1930, pages 91–95.

Three Ni-Cr cast irons from centrifugally cast cylinders were quenched in oil from 850° C. and in air from 875° C. They were tempered in salt at various temperatures. Tensile properties in the hardened state are very small but the strength is quickly recovered on tempering. Best properties are developed with tempering at 375–385°. The structure of tempered material is sorbitic. CHL(10a)

Deep Hardening of Structural Steels with Special Reference to the Effect of Cross-Section and Composition of the Steel (Die Durchvergütung von Konstruktionstählen unter Berücksichtigung des Einflusses von Stückquerschnitt und Legierung). H. Kallen & H. Schrader. *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 383–392.

A group of 14 various steels, composed of either straight C or Mn, Si, Cr, Cr-Mo and Cr-Ni steels was tested to determine the deep-hardening qualities. It is shown that the determination of the notch toughness may be suitably used for passing judgment on the hardening qualities. The yield point is still better qualified. Tensile strength, reduction of area and elongation give no clear picture. The proper ratio between yield point and tensile strength is of prime importance. Uniform deep hardening essentially depends upon the cross-section. Deep hardening is improved by alloys. The effect of various alloying elements together on the deep hardening qualities was studied. GN(10a)

Annealing (10b)

The Effect of Various Annealing Temperatures on Cold-Worked Low Carbon Steel. H. E. Publow, C. M. Heath & R. A. Gezelius. *Bulletin* No. 35, *Engineering Experiment Station, Michigan State College*, Mar. 1931, 17 pages, 22 figures.

Without appreciable change in micro-structure, low carbon steel (analysis not given) changes in hardness from 58 to 85 Rockwell B in drawing into brake drums. Olsen ductility tests for such a steel give 0.17″ deflection 9000 lbs./in.² at maximum load. Annealing at 1150–1250° F. for 1/2 hour, cooling at the rate of 7° F. per minute dropped the hardness to 60, and raised deflection to 0.36″, maximum load to over 11,000 lbs./in.² This gave better ductility than raising above the critical and cooling at that rate. Various other times and temperatures were tried. Much of the hardness produced by drawing into brake drums is acquired before the micro-structure shows apparent distortion of the grains. Annealing at 800° F. increases the hardness instead of decreasing it, prolonged heating below 1000° F. does not relieve internal strains, and the best annealing temperature is 1250–1300° F., i. e., just below the lower critical. HWG(10b)

Case Hardening & Nitrogen Hardening (10c)

Progress in Nitriding. Robert Sergeson. *Metal Progress*, Vol. 1, Oct. 1930, pages 38–41.

A brief historical review of the progress made both in the process itself and equipment used and in the development and economical production of suitable steels. Properties and applications discussed. WHK(10c)

Recent Developments in Nitriding. R. Sergeson (Republic Steel Corp.). *Iron Age*, Vol. 126, Sept. 11, 1930, pages 680–682.

Nitrided steels are heat treated to develop high physical properties. Attempts to nitride annealed structures result in a brittle part. On solid sections a growth 0.001 to 0.003 in. in diameter takes place depending on length of time of nitriding. Nitrided surfaces resist erosion, corrosion and abrasion. Recent furnace and nitriding container developments will lower cost of nitriding. Free machining of nitriding steels now possible by addition of sulphur. Tinning offers best protection for parts to be machined after nitriding. If part is merely to be kept soft the following mixture is used: 1 part sodium silicate by volume; 2 parts chrome ore (150 mesh) by volume. Composition of nitriding steel now used:

Carbon %	Manganese %	Chromium %	Aluminum %	Molybdenum %
0.10–0.20	0.40–0.70	0.80–1.30	0.60–1.20	0.15–0.25
0.20–0.30	0.40–0.70	0.80–1.30	0.60–1.20	0.15–0.25
0.30–0.40	0.40–0.70	0.80–1.30	0.60–1.20	0.15–0.25
0.55–0.65	0.40–0.70	0.80–1.30	0.60–1.20	0.15–0.25

VSP(10c)

The Development of Nitriding Plants (Die Entwicklung der Nitrieranlagen). F. Brühl. *Krupp'sche Monatshefte*, Vol. 11, Nov. 1930, pages 287–290.

The article briefly considers the nitriding process and gives an illustrated description of the latest development of German, French and American nitriding furnaces. GN(10c)

Correlation of the Crystal Structures and Hardness of Nitrided Cases. O. E. Harder & George B. Todd. *Fuels & Furnaces*, Vol. 9, Mar. 1931, pages, 295–297.

This is considerably condensed from a paper presented to the National Western Metals Congress. There is a fuller extract in *Steel*, Vol. 88, Mar. 19, 1931, pages 51–52. MS(10c)

Continuous Nitriding. R. J. Cowan. *Metal Progress*, Vol. 1, Oct. 1930, pages 93–98.

A description of a furnace and method for continuous nitriding. The furnace is of the pusher type, with a continuous gas-tight metal muffle extending throughout, charging and discharging being done through liquid seals. Burners are arranged in zones so that any temperature cycle can be maintained. The advantage of the method is that, since the ammonia is admitted at the cold end of the furnace, the metal surfaces under treatment are being continuously exposed to ammonia of a degree of dissociation suited to the temperature of the work. A series of hardness-depth curves for various degrees of dissociation are given to prove the correctness of the method. WHK(10c)

Nitriding Process of Nitrogen Case Hardening. J. E. Hurst. *Iron & Steel Industry & British Foundryman*, Vol. 3, Aug. 1930, pages 351–354; Sept. 1930, pages 379–380.

Use and factors affecting the nitriding process for various types of steels are discussed. CHL(10c)

Quenching (10d)

Heat Treatment of Carburized Parts. H. M. McQuaid. *Iron & Steel of Canada*, Vol. 14, Feb. 1931, pages 22–24.

An article reprinted from Houghton's "Black & White," in which McQuaid points out that a considerable amount of steel, which at the present time is being given the costly double treatment subsequent to carburizing, might quite successfully be quenched directly from the carburizing box. The 3 methods of single-quenching carburized work are discussed, and the types of steel suitable for use when these methods are employed are described. The article closes with a statement of the proper procedure to follow in establishing the proper heat treatment of a carburized part, assuming that the analysis selected has been chosen as the result of a careful study of the stresses and service to be met with in use. OWE(10d)

Drawing (10e)

Drawing of High-Speed Steels (Revenus des aciers rapides trempés). André Michel & Pierre Benazet. *Comptes Rendus de L'Académie des Sciences*, Vol. 192, Jan. 19, 1931, pages 163–166.

The authors describe experiments conducted with the Chévenard dilatometer on high-speed steel containing 11.09% cobalt. On the basis of these experiments the authors conclude that a single draw at a temperature less than 700° C. does not result in destruction of the austenite retained by quenching. To effect transformation a number of draws is necessary, this number becoming less as the temperature is increased. The maximum hardness obtained becomes greater as the drawing temperature is raised. The time of drawing and the speed of cooling have little influence on the effects noted. OWE(10e)

Aging (10f)

"Age Hardening" or "Improvement" of Alloys (Die "Vergütung" oder "Veredelung" von Legierungen). W. Guertler. *Zeitschrift für Metallkunde*, Vol. 22, Mar. 1930, pages 78–84.

Paper presented at the annual meeting of the *Deutsche Gesellschaft für Metallkunde*, Sept. 1929. See *Metals & Alloys*, Vol. 1, Oct. 1929, page 181. EF(10f)

The Aging of Iron and Steel. R. F. Mehl. *Iron & Steel of Canada*, Vol. 13, Dec. 1930, pages 265–287.

Report of lecture delivered at the Ontario Research Foundation, in which a very complete discussion of the types of phenomena which are grouped under the general heading, "Aging of Iron and Steel," is given. The article is illustrated by 21 diagrams and constitutes a very useful résumé of our present knowledge of this subject. OWE(10f)

The Artificial Ageing of Duralumin and Super-Duralumin. K. L. Meissner. *Engineering*, Oct. 10, 1930, Vol. 130, pages 473–475.

Condensed from paper read before the Institute of Metals, Southampton, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. LFM(10f)

The Theoretical Foundation of Duralumin-Like Age-Hardening in Ternary Systems. (Die phasentheoretischen Grundlagen der duraluminartigen Vergütung im Dreistoffsystem.) E. Scheil (Vereinigte Stahlwerke-Dortmund). *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, pages 297–302; discussion pages 302–303. 16 illustrations.

The author deduces from theoretical considerations the various possibilities of precipitations in ternary diagrams leading to age-hardening phenomena as encountered in duralumin. Some special problems concerning the hardening of alloyed steels are dealt with in conclusion. Lecture was delivered at the Meeting of the Deutsche Gesellschaft für Metallkunde Berlin, March 1930. EF(10f)

Malleablizing (10g)

Carbon Loss and Diffusion in the Malleablizing Process. Enrique Touceda. *Metals & Alloys*, Vol. 1, Nov. 1930, page 815.

A set of 8 hard iron blocks in which the C content varied from 1.99 to 2.66% was cut to size. Each specimen originated in a different source. All were placed correspondingly in an oven packed with burnt molding and tumbling barrel sand. They were then subjected to an average annealing cycle. Micro-examinations were made before and after treatment. Successive layers were machined off for C analysis. The data indicate that there is an average loss of 0.35% of the actual C during malleabilization. It appears that the diffusion of C toward the surface practically ceases at a depth of 7/16″. ESC(10g)

JOINING OF METALS & ALLOYS (11)

Metal Joints in Aircraft Construction. T. Watson Downes. *Proceedings American Society Testing Materials*. Vol. 30, Pt. 2, 1930, pages 127–139.

Discussion appended. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. (11)

The Joining of Aluminum and Its Alloys (La saldatura dell'alluminio e delle sue leghe). U. Magnani & C. Panseri. *La Metallurgia Italiana*, Vol. 23, Feb. 1931, pages 85–101, 26 references.

Methods for oxyacetylene welding, spot welding and hammer welding are briefly discussed. Compositions of several chloride-fluoride fluxes are given. A table of 20 compositions of solders for Al is given. These are mostly based on Sn-Zn mixtures. Zn-Cd alloys with 25 and 40% Cd and an alloy of 64 Bi, 36 Sn are also mentioned. Midway between straight welding and true soldering comes joining by means of Al alloys containing Si, Cu, Mn, Zn, etc. These are only briefly mentioned. As a curiosity is mentioned a suggestion to solder by reaction of Al with Zn salts whereby Zn is precipitated. Autogenous welding, applied with care, is applicable to pure Al where corrosion will be met, but soldered joints and adjacent metal must be protected as by varnish. Soldering is useful for repair purposes, but is seldom satisfactory from all points of view. A list of tests that may be applied to welded and soldered joints is given without details. HWG(11)

Adhesives and Adhesion. Some Mechanical Properties of Materials and Glued Metal Joints. W. B. Lee. *Industrial & Engineering Chemistry*, Vol. 22, July 1930, pages 778–780.

It has been shown that long-continued stress reduces the ultimate strength of metal joints glued with recognized adhesives, that joints between sandblasted metal surfaces made with the same shellac adhesive are weaker the greater the pressure employed in sandblasting. The relative strength of joints between smooth nickel surfaces made with various common adhesives is summarized graphically. 13 references. MEH(11)

Brazing (11a)

Electric Brazing Equipment. *Electric Railway Journal*, Vol. 75, Feb. 1931, page 103.

An equipment utilizing the resistance properties of carbon black blocks to generate heat is marketed by the General Electric Co. It consists of a transformer, fork switch and tongs for holding the carbon blocks and work. The sizes of the various parts depend on the size of the work and the joints to be made. The parts to be brazed are either designed with flat surfaces or are flattened before brazing. WHB(11a)

Resistance Brazing. *Metal Progress*, Vol. 1, Sept. 1930, pages 54–56.

The application of low voltage resistance heating to brazing and silver soldering as developed by the General Electric Co. is discussed. WHK(11a)

Soldering (11b)

Repairing Pewter. A. Eyles. *Brass World*, Vol. 27, Feb. 1931, pages 27–28.

The handling of pewter in the old days is outlined and practical notes given for the reconditioning of old pewter vessels. When repairing old pewter dents must be removed and all surfaces must be perfectly clean. A good solder contains: bismuth 50%, tin 25%, and lead 25%. Fluxes used include: rosin, Gallipoli oil, olive oil, and a mixture of rosin and olive oil. WHB(11b)

Welding & Cutting (11c)

Electric Welding of Steel. T. McLean Jasper. *Journal Western Society of Engineers*, Vol. 35, Dec. 1930, pages 415–422.

General information is given about the application of welding in manufacturing, with particular attention to large products such as welded pressure vessels. The fundamental principles of good welding are touched upon. A code, specifying the exact procedure of welding, is obsolete and fundamentally impossible. "The manufacturer who proposes to weld boilers should be willing to build a full size vessel of maximum dimensions and test it to destruction. It is hoped that the Boiler Code Committee will eventually protect the user by requiring adequate testing of the finished product." GTM+WHB(11c)

How Dissimilar and Non-Ferrous Metals Can Be Successfully Spot Welded. Part I. P. T. Gillette. *Welding*, Vol. 1, Jan. 1930, pages 163–166.

The first of a series of 7 articles by different authorities on electric resistance welding. The use of a correct combination of Elkonite-tipped electrodes, with proper observance of the factors of time, current and pressure, makes spot welding of dissimilar metals easy. The manner in which the combinations of Elkonite electrodes give a balanced heating effect is discussed. Each combination of metals and alloys must be studied as a separate problem. Tables are appended showing size of welders for dissimilar metals and also spot welds successfully made with Elkonite electrodes. ACW(11c)

Welding Processes Applicable to Aluminum. W. M. Dunlap (Aluminum Company of America). *Preprint, American Society for Testing Materials*, Mar. 1931, 4 pages.

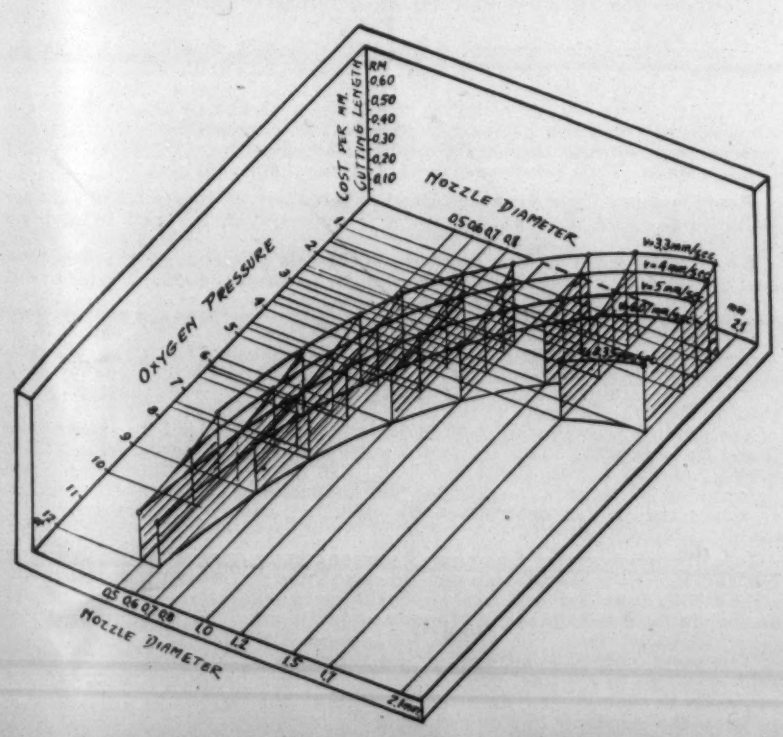
General discussion of welding methods useful for Al and its alloys, with the advantages and drawbacks of each. Fluxes are referred to as necessary, but no details given as to satisfactory ones. HWG(11c)

Economies Result from Welded-On Overlays and Heat Treatment. Miles Catlin Smith (Stoody Co.). *Iron Age*, Vol. 126, Nov. 13, 1930, pages 1370–1371, 1437–1438.

Paper presented before the American Society for Steel Treating at Chicago. Object of investigation was to ascertain value of welded-on overlays as surface preparation for machine and other parts. VSP(11c)

Investigations on Economical Oxy-Acetylene Cutting (Untersuchungen über wirtschaftliches Brennschneiden). C. Assmann. *Autogene Metallbearbeitung*, Vol. 24, Jan. 1, 1931, pages 4–14; Jan. 15, 1931, pages 26–32.

Exhaustive tests with oxy-acetylene burners for metal cutting regarding pressure loss between reducing valve and burner, oxygen consumption under different operating conditions, and cutting groove were made systematically on ordinary wrought iron plates of 16, 30, and 50 mm. thickness. Straight cuts 600 mm. in length were made and the flame adjusted to a consumption of 200 l. of acetylene/hr. The oxygen used in these tests had a purity of 99.0–99.1%. The whole arrangement and the apparatus are described in detail. The results illustrated by a great number of tables, curves and microphotographs have shown the following facts: (1) The oxygen consumption/unit length of cut depends mainly on the diameter of the burner nozzle; for the same cutting velocity, the oxygen consumption is less for small nozzles and high pressures of oxygen than for large nozzles and low pressures. (2) Within the limits used in practice, the cutting velocity has only slight influence on the specific oxygen consumption for cutting. (3) The cutting velocity can be increased both by increase of the oxygen pressure and by the use of larger cutting nozzle. (4) In order to cut economically, it is not sufficient to attempt to obtain the lowest possible oxygen consumption; it is rather necessary to also take into account the cost of heating gas (acetylene) and wages. These 2 factors become smaller for increased cutting velocity. It is, therefore, often advisable to use a larger nozzle in spite of its higher oxygen consumption because the saving in wages and cost of acetylene are greater than the higher costs for oxygen. In addition to the above-mentioned factors, the economy of cutting depends upon the purity and humidity of the oxygen, kind of heating gas, size and type of flame, etc. (5) The tested burners and valves showed considerable pressure losses between reducing valve and burner nozzle for large flows of oxygen. In the construction of cutting burners, care should, therefore, be taken that the passages for oxygen have sufficiently large sections and no sharp curves. (6) The width of the cutting groove increases with the size of the nozzle, increase of oxygen pressure, and distance of nozzle from surface of material. The illustration shows the cost for 1 mm. cutting length as a function of diameter of nozzle pressure and cutting velocity for a 30 mm. wrought iron plate. For the calculation of costs, a price for oxygen of RM 0.40/m.³, of acetylene of RM 2.65, and wages and overhead of RM 2.0 has been assumed. Ha(11c)



The Welding Shop of the Verband für Autogene Metallbearbeitung Branch Mannheim-Ludwigshafen (Die Schweisswerkstätte der Ortgruppe Mannheimludwigshafen). H. Tuergens. *Schmelzschweissung*, Vol. 10, Jan. 1931, pages 1–3.

Description of the school where welding courses are given. 30 pupils can be instructed at one time. Ha(11c)

Quick Spot-Welding Machine. (Schnell - Punktschweiss - machine.) Stuemer. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 22, 1930, page 1616.

Brief information on a machine to be used for quantity production with particularly large transformer to develop great local instantaneous heating. Ha(11c)

A Training Course for Arc Welders. Parts I–II. Samuel Martin, Jr. *Welding*, Vol. 1, May 1930, pages 464–467; June 1930, pages 525–527, 542.

Because of the rapid increase in the use of arc welding, the available supply of first-class operators for arc welding equipment has never been adequate to the demand. It is a good investment to maintain a training course or to send employees to a welding school, for good operators return large dividends in actual production, in addition to obtaining maximum usage from invested capital. Discusses planning the course, essential equipment, additional equipment for larger schools, qualifications for instructor, selecting students, training course, procedure common to each lesson. Outlines a course of 40 lessons to be performed, one a day. Includes a table of welding characteristics of various special and alloy steels. W(11c)

Hard Surfacing with Oxy-Acetylene Welding Torch. Miles C. Smith *Welding*, Vol. 1, May 1930, pages 458–461.

Discussion of desirable prerequisite knowledge, manner of procedure and limitations of application of hard facings. W(11c)

Compression Rods for Welded Structures (Knickstäbe für geschweisste Bauten). Karl Melcher. *Schmelzschweissung*, Vol. 10, Jan. 1931, pages 9–12.

The introduction of welding has made possible the joining of profiles or structural shapes which could hardly be joined by riveting or bolting. The paper investigates different sections with regard to their suitability for welding and gives comparative results for angle-irons, U-irons, and semi-circular and full pipes and illustrates with examples. As a particularly useful and strong combination is mentioned 2 channels welded with their short flanges against a flat plate, thus forming a kind of hollow pillar. This combination sometimes results in a saving of 50% of the weight. Ha(11c)

Oxy-Acetylene Cutting of Structural and Alloyed Steels (Ueber das autogene Schneiden von Baustählen und legierten Stählen). *Communication from the Research Laboratory of the "Works Autogen" of the I. G. Farbenindustries A.-G.—Frankfurt a.M. Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 5, 1930, pages 25–54.

This research was undertaken to clear up several questions with reference to the influence which oxy-acetylene welding has on the cutting edges of the material. From the test results which are given in tables and illustrated by many photographs, it could be concluded that the nature of the surface of the cut after cutting (whether more or less smooth) is of much greater importance than the transformations in the material because the latter represents rather a refining of the material by heat treatment; a subsequent machining by drilling, planing, etc., might destroy all this improvement. The reports recommended, therefore, that no objection need be raised against oxy-acetylene cutting even in cases where, so far, usually other mechanical means have been specified, such as in boiler manufacture, shipbuilding, etc. The appearance of the surface gives a good index to the quality of the cut. The manufacturing cost can usually be materially reduced. Ha(11c)

Psychological Tests of Acetylene Welders (Psychotechnische Untersuchungen der Acetylenschweisser). P. Tulacz. *Schmelzschweissung*, Vol. 10, Jan. 1931, pages 7–8.

This paper was read at the Tenth International Acetylene Congress in Zurich, 1930, and discusses methods and tests to determine whether a man (1) is fit to be a welder; (2) is fit for a particular, especially difficult kind of work. Optical and mental qualities required and the tests to determine them were discussed. Tests, however, will still have to be developed for obtaining reliable judgments. Ha(11c)

Mixing of the Gases in the Oxy-acetylene Welding Burner (Mischung im Azetylene-Sauerstoff-Schweissbrenner). E. Streb. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*. Series 5, 1930, pages 93–99.

The question of homogeneity of the gas mixture in oxy-acetylene burners is solved by the flow of the gases in the burner tube, by the chemical analysis of the gas mixture in the section of the mouth, by the ignition velocity at the mouth of the burners, and by the welding output. The results of these investigations permit the conclusion that the mixture escaping from the burner is, in all systems, homogeneous. The ignition velocity for different mixture of acetylene and oxygen never becomes greater than the escaping velocity at the mouth of the burner. Ha(11c)

Symposium of Weld Testing Establishes Important Facts. *Iron Age*, Vol. 126, Dec. 4, 1930, pages 1680–1681, 1698.

Held at fall meeting of the American Welding Society. Committee on standard tests of the Bureau of Welding decided that standards adopted in 1921 need revision to provide standardized and simpler procedures for various mechanical tests in connection with needs. Three standard tests proposed as reliable: Tension, bending and shear. Endurance limit usually $^1/_3$ of tensile strength of weld. Gamma ray from radium suitable for examining welds up to 12 in. VSP(11c)

Heavily Coated Electrode for Quality Welding. *Electrical World*, Vol. 97, Mar. 28, 1931, page 616.

The General Electric Co. has marketed an electrode composed of 0.13–0.18% carbon steel covered with a heavy coating of cotton braid impregnated with an arc stabilizing flux and is available in diameters from $^1/_8$–$^3/_8$". Metal deposits of this electrode will have a high tensile strength and will produce a homogeneous structure resulting in a ductile weld. Extreme arc stability and high arc voltages permissible produce an unusually high speed of welding for certain applications. WHB(11c)

Electric Welding—the New Tool of Industry. *Electrical World*, Vol. 27, Mar. 1931, pages 636–638.

A number of illustrations show different types of electric welding in various applications. WHB(11c)

The Quality of Materials for Fusion Welding. C. R. Texter & F. M. Speller (National Tube Company). *Preprint, American Society for Testing Materials*, Mar. 1931, 8 pages.

While welding is most often performed on steel with C not over 0.30%, higher C material, and even intermediate Mn rail steel can be welded, open-hearth steel is generally preferred to Bessemer for welding. Steel that is laminated, due to too small a top crop, may give trouble. In general, welding equipment, fluxes and technique can be chosen to handle almost any material it is desired to weld, and these are of more importance than the composition of the material. Various specifications for material to be welded and for welding rod and filler are cited. HWG(11c)

Resistance Welded Pipe. Ernest E. Thum. *Metal Progress*, Vol. 1, Sept. 1930, pages 33–37.

The development of this latest method of manufacturing pipe is traced. The steps in the process and the testing methods are discussed. WHK(11c)

Welding in the Steel Foundry. I. H. Namack & H. C. Hobart. *Metal Progress*, Vol. 1, Oct. 1930, pages 71–74.

The advantages of fabricating complicated shapes difficult to cast in one piece by the welding of simpler castings is described. WHK(11c)

Canada's First Large Arc Electric Welded Steel Structure Erected. H. B. HANNA. *Iron & Steel of Canada*, Vol. 13, Dec. 1930, pages 271–274.

A complete description, illustrated by 11 photographs, of a new addition to the Peterboro plant of the Canadian General Electric Company. The building has a floor area of 72,000 ft.², the bays being 80 ft. wide, and the columns spaced 25-foot centers. The steel frame weighs approximately 960 tons. It is interesting to note that the lowest breaking stress attained by any welder working on this building was 12,250 lb./linear inch for $^3/_8'' \times {}^3/_8''$ fillets. OWE(11c)

Resistance Control. Thyratron Control Equipment for High-Speed Resistance Welding. R. C. GRIFFITH (General Electric Co.). *General Electric Review*, Vol. 33, Sept. 1930, pages 511–513.

Thyratron tubes have been used as make-and-break device in control equipment to answer the severe requirements of interrupted line welding. The control system and novel features of the applications are discussed. WHB(11c)

Investigations of the Most Favorable Mixture-Ratio in Acetylene-welding of Steels with Low Carbon Contents (Untersuchungen über das günstigste Mischungsverhaltnis bei der Azetylen-Schweissung von Stählen mit geringem Kohlenstoffgehalte). O. MUES. *Forschungsarbeiten auf dem Gebiete der Azetylen-Schweissung*, Jan. 1930, pages 25–52.

Briefly expressed, the extensive research had the following results: (1) The oxy-acetylene welding flame has, for ratios of oxygen to acetylene from 1.0 to 1.4, a neutral core in the flame center where neither carbonizing nor oxidation of the melt takes place. This neutral zone is largest for the ratio 1.0. (2) Tests with ratios from 0.89 to 2.09 showed the best quality of the melt at a ratio of 1.0 to 1.1. (3) The hardness of the seam reduces with increasing ratio. (4) Within the ratio of 0.89 to 2.09, the output of the welding increases with increasing ratio. (5) The least change of the mixture ratio for changes of pressure before the burner occurred in burners for equal pressures, greater changes in injector-burners, and the largest in mixing-nozzle burners. (6) The heating of the burner-head causes, in all burners except the uni-pressure burner, a change in the mixture-ratio. (7) The back-firing velocity of the free upward burning flame increases in the examined ratios with increasing ratio and increasing temperature of the mixture. For details, reference must be made to the paper; there are 27 references and 6 pages of tables illustrating test results. Ha(11c)

General Survey of Welding Processes. F. T. LLEWELLYN (U. S. Steel Corp.). *Preprint, American Society for Testing Materials*, Mar. 1931, 15 pages.

Condensed general description and classification of all welding processes. This is to appear also in the A.S.S.T. Handbook. HWG(11c)

Welding in the Chemical Industry. F. LEVERICK. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 448–451.

This is a discussion of welding as compared with other methods of joining, the different types of welds, the precautions to be observed in the welding of corrosion-proof metals, all from the point of view of the engineer who is responsible for the installation of chemical plant equipment. MPB(11c)

English Practice in Repair Welding. A. ANDREWS. *American Machinist*, Vol. 73, Dec. 25, 1930, page 1002.

Oxy-acetylene is favored for aluminum castings. Electric arc is more rapid for other work. Welding rods should be of about the same composition as the casting to be welded. Preheating is usually required for aluminum castings. Flux should be washed off to prevent future corrosion. RHP(11c)

Welding of Duralumin in Aircraft. EDWIN JOYCE. *Welding*, Vol. I, May 1930, pages 447–453.

Based on research work being done at U. S. Naval Aircraft Factory, Philadelphia, Pa. Discusses experimental data on duralumin, heat treatment of welds, composition of flux recommended, prevention of distortion, importance of properly formed flanges, scleroscope hardness readings, combating corrosion. Includes 2 tables on results of tensile tests of oxy-hydrogen flame, flange welded 0.045 gage and 0.029 gage duralumin and graphs of scleroscope hardness of welded duralumin sheet. ACW(11c)

Development of a Code for Fusion Welded Boiler Drums. C. W. OBERT. *Metal Progress*, Vol. 1, Sept. 1930, pages 75–78.

Discussion of the present status of fusion welding and the pending revisions of the A.S.M.E. Boiler Code. See *Metals & Alloys*, Vol. 1, Apr. 1930, page 475. WHK(11c)

Welding of Formed and Fabricated Sheet Metal Parts. J. B. GREEN (Fusion Welding Corp.). *Metal Stampings*, Vol. 3, Mar. 1930, pages 267–270.

Welding of thin steel sheets is very largely a matter of precision heat control. Metallic arc process is unsuitable for sheets thinner than No. 14 gage because of wide variation in the heat developed from instant to instant. Carbon arc tends to pull off from the cold steel along the edges of the weld. Thin sheets can be welded satisfactorily by means of a combination of a carbon arc and a suitably fluxed welding wire developed for the purpose. Flux-protected metal steadies arc and insures the path of least resistance for the arc stream to lie between the carbon point and the hottest spot. Cross-section of the wire is so proportioned to the thickness of the sheets that an inch of weld seam can be laid down with an inch of wire. Specially designed generator provides precision heat control. Sheets down to No. 30 gage can be welded by this process. Al, Cu and "18–8" and other alloy steel sheets may be welded by using special fluxes. MS(11c)

Riveting (11d)

Studies of Lautal, with Special Consideration of Riveting Lautal (Untersuchungen an Lautal unter besonderer Berücksichtigung der Lautalnietung). OTTO REPP. *Hauszeitschrift der V. A. W. und Erftwerk für Aluminium*, Dec. 1930, pages 229–279.

The paper gives a complete account of the mechanical-technological investigation of the light metal, "Lautal," which is composed of 94% Al, 4% Cu, 2% Si, has a density of 2.75 and is normally annealed at 500° C., quenched, and again tempered at 120–150° C. Tests were made with rounds or sheets. Static and dynamic tests were made. The rivets are cold pressed into the rivet holes, the energy transmission acts, therefore, contrary to the hot method for steel, not by friction of the sheets against each other, but by pressure in the hole and compression in the rivet. The principles of calculation are derived and coefficients for stresses are given. The test results are shown in numerous tables to which the reader must be referred. Ha(11d)

Riveting of Aluminum and Its Alloys. (Note sulla Chiodatura dell'alluminio e sue leghe). U. MAGNANI & C. PANSERI. *La Metallurgia Italiana*, Vol. 23, Jan. 1931, pages 1–17.

General discussion of riveting heat-treatable Al alloys, with some comment on electrolytic corrosion where these alloys are in contact with others, on protective coatings, and on thermal coefficient of expansion. HWG(11d)

Riveting Aluminum and Its Alloys. *American Machinist*, Vol. 73, Oct. 16, 1930, page 637.

Abstracted from "The Riveting of Aluminum and Its Alloys" by Permission of the Aluminum Company of American. RHP(11d)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Deoxidation and Mold Conditions on the Tensile Properties of Carbon Steel Castings. J. V. MCCRAE & R. L. DOWDELL. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 159–211; *Rolling Mill Journal*, Vol. 4, Oct. 1930, pages 521, 524, 552.

Paper presented before 12th annual Convention of the Society in Chicago Sept. 1930, with discussion, containing 7 references. The paper discusses the difficulties of meeting in C steel castings a specification of minimum tensile strength 60,000 lb./in.², minimum yield point 45% of tensile strength, minimum elongation in 2 inches 24% and minimum reduction of area 35%, determined on a 0.505 in. tensile specimen. This specification is quite generally met by casting in dry sand molds but reasons of economy make green sand desirable and here difficulties of porosity are encountered. This may be eliminated by the use of Al in the ladle but results in decreased ductility. To determine the extent of these difficulties 100 consecutive heats from one foundry and 32 (not all consecutive) heats from another foundry were studied. The plan involved the varying of ordinary foundry conditions such as green and dry sand molds, design of test castings, heat treatment, casting temperature, character of scrap and various deoxidizers and deoxidation conditions. The melting was in $2^1/_2$ ton Heroult and 2 ton Greaves-Etchell furnaces and the practice was normal for acid electric castings. Composition study showed low C, 0.13–0.18, most easily meet the specification when made under "standard melting" conditions. Thermal analysis showed Ac_3 to be higher in these castings than in wrought steels of the same composition. Higher temperatures of normalizing failed to increase ductility. Of various treatments tried such as quenching and tempering, higher normalizing, and the various draws, a draw of 1300° F. after the usual 1650° F. normalize improved the ductility of poor heats but had no appreciable effect on good heats. Use of higher casting temperatures appears beneficial. Character of the scrap appears to be of little influence though the use of large amounts of heavy scrap is preferable. Addition of small amounts of Ni and Va appear to have no virtue. Of various deoxidizers tried none showed better ductility than Al and some very inferior results. Al alloys have the same effect as an equal amount of Al as such. Inclusions of Al_2O_3 appear to be the cause of low ductility when Al is used. Mold preparations in the form of surface treatments may give desired results but do not appear very promising. In discussion W. C. Hamilton (American Steel Foundries) summarizes the results presented and reports experience with open-hearth steel for castings and use of Al. A. W. Lorenz (Bucyrus-Erie Co.) presents data on the addition of Al to open-hearth steel for castings. MS + WLC(12a)

Making and Working White Gold. (Herstellung und Bearbeitung von Weissgoldlegierungen.) EDMUND RICHARD THEWS. *Deutsche Goldschmeide Zeitung*, Vol. 34, Mar. 14, 1931, pages 112–113.

The Au-Pd alloys are easier to work and more resistant to tarnishing than the Au-Ni-Zn alloys, but the latter are usually used because they are much cheaper. The quality of the Au-Ni-Zn alloys is dependent on the method of melting. They should be prepared by melting the Ni under a borax cover, gradually adding the Au, cooling to 1050° or 1100° C., deoxidizing with Mg, stirring the Zn in, and finally adding Mg before casting. Remelted alloys may differ from alloys made from new metals. The Au-Ni-Zn alloys are harder than the yellow or red-gold alloys, and much more difficult to work. They are particularly susceptible to rapid changes in temperature, and while hot should not be dipped into the pickling solution. They should be annealed at not over a dark cherry red. At annealing or heating for soldering they should be protected from the O_2 of the air by a covering such as borax. They can be pickled in a 10% H_2SO_4 solution. Directions are also given for electrolytic cleaning. For plating a Au-Cd solution is recommended. JLG(12a)

Iron and Steel Foundry Practice. Part 7. BEN SHAW. *Metallurgia*, Vol. 3, Jan. 1931, pages 104–108.

Describes the usual arc and induction furnaces used in steel melting. JLG(12a)

Some Metallurgical Points on Acid Open-Hearth and Electric Steel for Castings. F. A. MELMOTH. *American Foundrymen's Association, Preprint* No. 31–5, 1931, 25 pages.

Indications are that, although chemically identical, open-hearth and electric steels are not necessarily identical in constitution. Non-metallic inclusions in electric steel are considered as cause for differences in the 2 types of steel. Their presence may be of ultra-microscopic size. CHL(12a)

Reverberatory Type Furnaces Used in Recovery of Waste from Tin-Base Babbitting. P. J. POTTER. *Fuels & Furnaces*, Vol. 8, Mar. 1930, pages 393–394.

From paper read before Institute of Metals Division of the *American Institute of Mining and Metallurgical Engineers*, Sept. 1929. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 388. (12a)

The Carbon-oxygen Equilibrium in Liquid Iron. H. C. VACHER & E. H. HAMILTON (U. S. Bureau of Standards). *Technical Publication* No. 409, *American Institute Mining & Metallurgical Engineers*, 1931, 17 pages.

Alloys containing various concentrations of C and O were prepared by controlling the CO_2/CO ratio of the gases in contact with the melt. The value of the product C·O in weight % at 1620° C. and 1 atmosphere pressure was found to be 0.0025. This value did not vary as the C varied from 0.01 to 0.94% and the O from 0.003 to 0.19%. In the higher C alloys the O was determined by deoxidation with Al and determining the Al_2O_3. In the low C alloys the O was determined by vacuum fusion. 7 references. JLG(12a)

Investigations on the Chemical Reactions in Making Acid Steels and in Deoxodizing with Manganese and Silicon (Untersuchungen über die chemischen Vorgänge bei den sauren Stahlerzeugungsverfahren und bei der Desoxydation des Stahles mit Mangan und Silizium). H. SCHENCK. *Archiv für Eisenhüttenwesen*, Vol. 4, Jan. 1931, pages 319–322.

The metallurgical similarity of the reactions of Mn and Si in making acid steel and in the final deoxidation process can be utilized to refer the 2 processes to each other. In order to establish the equilibria, it is necessary to know the constants of equilibrium of the reactions $FeO + Mn \leftrightarrows MnO + Fe$ and $2\,FeO + Si \quad SiO_2 + 2\,Fe$ as well as the constants of dissociation of the silicates of Fe and Mn. After presenting the present known thermal data, the constants of the above reactions were calculated, compared with other data and found suitable for application. The constants of dissociation of the Fe and Mn silicates were determined and the relations of equilibrium between metal bath, slag and the products of deoxidation diagrammatically represented. The deoxidation of Mn and Si steels is discussed. GN(12a)

Production of Gray Iron from Steel Scrap in the Electric Furnace. T. F. BAILEY. *Fuels & Furnace*, Vol. 8, May 1930, pages 667–669.

From a paper read before the American Institute of Mining and Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 568. MS(12a)

Thermal Balances and Fuel Costs of Malleable Melting Furnaces. J. H. HRUSKA. *American Foundrymen's Association, Preprint* No. 31–12, 1931, 15 pages.

A report on systematic studies endeavoring to correlate strictly metallurgical heat balances of melting furnaces together with actual costs of the mentioned amounts of B. t. u. for the fuels used as heat media. CHL(12a)

Melting of Gray and Malleable Iron in the Indirect-Arc Furnace. J. C. BENNETT & J. H. VOGEL. *American Foundrymen's Association, Preprint* No. 31-9, 1931, 19 pages.

Details are given of the operation of an indirect-arc furnace for melting both malleable and special gray-iron castings. Power, refractories, labor and electrodes costs are outlined. CHL(12a)

New Method for Determining Iron Oxide. C. H. HERTY, JR., J. M. GAINES, JR., H. FREEMAN & M. W. LIGHTNER. *Blast Furnace & Steel Plant*, Vol. 18, Mar. 1930, pages 468–471; condensed in *Fuels & Furnaces*, Vol. 8, June 1930, pages 843–844.

From *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 311. See *Metals & Alloys*, Vol. 1, June 1930, page 568. MS(12a)

Deoxidation of Steel with Silicon. C. H. HERTY, JR., G. R. FITTERER & C. F. CHRISTOPHER. *Bureau of Mines Technical Paper* 492, 1931, 42 pages.

The liquidus of the system $FeO-SiO_2$ has been studied over the range 45–100% FeO. The melting points of synthetic ferrous silicates were determined with the micropyrometer. Fayalite ($2FeO.SiO_2$) melted at 1335°. Two eutectics, at 65 and 78% FeO, were found; their melting points were 1260° and 1240°, respectively. The deoxidation constant for the reaction $2FeO + Si \rightleftarrows SiO_2 + 2Fe$ was determined to be $K_D = (Si)\ (FeO)^2 = 1.65 \times 10^{-4}$ when all concentrations are expressed as weight percent. Fluxing of silica by dissolved FeO was shown to be an important factor in the deoxidation of low-carbon steel. Steels high in silica are red-short in forging, while steels containing ferrous silicates high in FeO forged without cracking. The use of silicon as a deoxidizer in steel-making processes always results in the formation of silica or silicates, depending on the amount of silicon used and the concurrent use of other deoxidizers. If silicon is used alone the silica formed is extremely hard to eliminate. The oxidation of the metal in the basic open-hearth process increases as the carbon content decreases. The time required to eliminate silicates, resulting from deoxidation with silicon, from the steel bath was proportional to the depth of the bath and inversely to the size of the particles formed on deoxidation. Agitation of the bath assisted in cleaning it. High residual manganese had only a slight cleaning effect. Segregation of silicates in ingots from 20 lbs. to 3 tons in weight was studied. In top-poured steels the maximum segregation was in the center of the ingot about 15% from the bottom. An annular zone of high-silicate segregation was found in the upper portion of these ingots and is due to crystallization phenomena. In bottom-poured ingots segregation is more irregular and is complicated by erosion of runner brick. AHE(12a)

The Production of High-Manganese Slag in the Electric Furnace. T. L. JOSEPH, C. E. WOOD & E. P. BARRETT. *Bureau of Mines Report of Investigations* 3080, Feb. 1931, 9 pages.

Electric furnace tests made with 150-lb. charges of spiegel, containing about 15% Mn and 0.5% P indicate that 2 types of high-Mn slag may be produced from metal of this type. When silica was used as a thinning agent the slag had an average composition of MnO 68.1, FeO 5.2, SiO_2 14.3, P 0.11, and Al_2O_3 8.2%. With the exception of frothy slags, alumina worked as well as silica as a thinning agent, resulting in slag of the following average composition; MnO 69.6, FeO 6.1, SiO_2 8.7, P 0.16 and Al_2O_3 13.0%. The silica and alumina may be varied over a wide range provided their sum equals about 22% of the slag. A continuous cycle gave better results than a batch operation. From 85 to 90% of the Mn could be recovered in the slag, 3 to 6% in the metal and 6 to 8% lost. More strongly reducing conditions can be established in the electric furnace than in the open-hearth thus permitting more positive control of phosphorus and iron in the slag and reducing the treatment to about one-half. AHE(12a)

Casting & Solidification (12b)

Casting Railway Bronzes in Permanent Moulds. HENRI MARIUS. *Metal Industry*, London, Vol. 37, July 18, 1930, pages 55–58.

Permanent molding is superior to sand molding for it yields advantages in quality and reduction in cost. See *Metals & Alloys*, Vol. 1, June 1930, page 568. VSP(12b)

Permanent Mold Foundry Practice for Bronze Castings. HENRI MARIUS. *American Foundrymen's Association, Preprint* No. 31-3, 1931, 26 pages.

Cu-Sn alloys cast in iron molds have greater strength and hold more Pb than sand cast castings. Control of several foundry factors as pouring temperature, gating and risering, melting, is very important. CHL(12b)

Progress of Die-Casting Industry. MARC STEARN. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Dec. 1930, pages 723–736.

The importance of gating, venting and water cooling of die-casting dies are pointed out. Progress of the modern automatic casting machine is traced. CHL(12b)

Steel Ingot. HERBERT H. ASHDOWN (Consulting Metallurgist). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 129–158.

Paper presented before the 12th annual Convention of the Society in Chicago, Sept. 1930, with discussion. The paper discusses difficulties met in production of large ingots for forgings and gives details of small and large scale investigation of the causes of failures. Photographs of sulphur prints and macroetched sections show the occurrence of segregation in ingots discussed. The advantages of rotating ingots during casting, and the use of water cooled ingot molds to secure rapid solidification, arresting segregation, shortening pipe and producing a larger portion of sound material in each ingot are shown. The occurrence of ingot corner segregation and corner cracking is discussed. Virtues of big end up and big end down types of molds are discussed. The advantages of cylindrical ingots in eliminating corner segregation are covered. In discussion P. A. E. Armstrong proposes use of cylindrical ingot molds of Cu with a cast iron bottom to be mechanically dropped to allow the ingot to settle into contact with the mold as it contracts. Cu lends itself more readily to water cooling and has a much higher conductivity giving quicker and more effective relief of heat. WLC(12b)

The Casting of German Silver in Water-Cooled Chill Moulds. OTTO JUNKER (Lammersdorf, Kreis-Monschau). *Metal Industry*, London, Vol. 37, Aug. 1, 1930, pages 103–104.

Translation adapted from an article in *Metallwirtschaft*. Results given prove the economy of casting German silver sheet slabs in water cooled chill molds. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. VSP(12b)

The Centrifugal Casting of Metals. O. JUNKER. *Metal Industry*, London, Vol. 36, April 25, 1930, pages 453–454.

Adapted from communication by the author to *Metallwirtschaft*, Oct. 1929, page 1018. Describes the type of water cooled centrifugal mold. Attention is drawn to the method of admitting water in opposition to centrifugal force which is to insure complete contact of water with the mold. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. VSP(12b)

Some Notes on Teeming Speeds of Ingots. A. JACKSON. *Iron & Steel Industry & British Foundryman*, Vol. 4, Feb. 1931, pages 167–170.

A study of 6 ton ingots show that too rapid teeming rate tends to cause cracking of ingots. CHL(12b)

Crystallization and Segregation in Small 1.10 Percent Carbon Steel Ingots. AXEL HULTGREN. *Rolling Mill Journal*, Vol. 4, Mar. 1930, pages 107–108.

Abstract of a paper read before the *Iron & Steel Institute*. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 388. MS(12b)

Rolling (12c)

Malleability of Rolled Soft Steel, and a New Method for Its Improvement. JOSEPH VIETORISZ. *Carnegie Scholarship Memoirs, Iron & Steel Institute*, Vol. 19, 1930, pages 167–213.

The author has studied the effect of various rolling temperatures from 200–1300° C. on the properties of soft steel. He finds a critical range between 700° and 850° C. where the mechanical properties are very poor. At 900° C. the elongation reaches its highest value and lowest at 300°. "Hot" rolling, above the critical range, gives a comparatively low yield point but 850–1000° C. gives the highest values. If lower elongation is satisfactory much higher yield point may be obtained by "cold" rolling at 200–400° C. A micro-structural study was made with grain counts tabulated and 37 micrographs. The steel studied analyzed C 0.05%, Mn 0.29%, P 0.02%, S 0.035% and Si a trace. 6 references. WLC(12c)

Calculation of the Spread of a Rail Pass (Ueber die Ermittlung der Breitung bei einem dem Schienenstaucherähnlichen Profilstich). H. PUPPE. *Stahl und Eisen*, Vol. 50, Oct. 30, 1930, page 1529.

The author describes a method for calculating the spread of the material of a rail, so as to allow sufficiently for properly finishing the flanges of long rails. GN(12c)

Useful Work and Lost Work in Rolling (Nutzarbeit und Verlustarbeit beim Walzen). E. SIEBEL & A. POMP. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, No. 11, Report 153, pages 149–159.

The losses in cold and hot rolling were studied. The high losses in cold rolling are attributed to friction in the bearings. Roller bearings with pressure lubrication gave the best results. The ratio of the losses to the total work done is smaller in hot rolling, due, primarily, to the fact that the angle of grip is larger in hot rolling than in cold rolling, so that, for equal amounts of work, the roll pressure is less and, therefore, smaller frictional losses occur. A mathematical consideration of the forces generated by rolling is given. GN(12c)

On the Cross-rolling Method in Rolling Large Seamless Tubes (Ueber Querwalzverfahren zur Herstellung grosser nahtloser Rohre). K. GRUBER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 162, pages 285–297; *Stahl und Eisen*, Vol. 50, Dec. 18, 1930, page 1788.

The article deals with pass and mandrel design in rolling seamless tubes. The main conditions which must be fulfilled are as follows. (1) Rolls and rolled material shall be rotation bodies which are always in contact. (2) A twisting of the material should be avoided during the rolling process. (3) The rolling speed in the direction of the axis of the material should be constant. The second condition cannot be fulfilled accurately. Practical results check the above theoretical considerations. Data on the power consumption are included in the paper. GN(12c)

The Rolling of Alloys of Copper and Phosphorus Containing up to 5 Per Cent of Phosphorus. OWEN W. ELLIS (Ontario Research Foundation). *Institute of Metals, Advance Copy* No. 551, 1931, 6 pages; *Metal Industry*, London, Vol. 38, Mar. 20, 1931, pages 315–316.

Contrary to recent reports Cu containing as much as 5% P can be rolled. Sheets for brazing have been rolled to 0.015 in. The Cu-P alloys were rolled at a temperature of 450° C. or above to between 0.02 and 0.04 in., and then rolled cold. A strip of the 5% P alloy, 0.018 in. thick had a tensile strength of 88,000 lbs./in.^{2} and practically no elongation. PRK + JLG(12c)

Forging (12d)

Forging Practice in U. S. Naval Gun Factory. W. L. BLANKENSHIP. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 73–99.

Paper presented before the 12th annual Convention of the Society, Chicago, Sept. 1930, with discussion. The limitations of space and weight available and the necessity for the utmost reliability in Naval Ordnance make the manufacture of naval forgings a very exacting work. The author gives various compositions used and mentions applications. The question of quality in the metal for forgings is discussed with details for the production of certain forgings and tests used for control of quality. The forging of aluminum bronze for naval work is discussed and physical properties given. The paper is concluded with a discussion of projectile forgings and special equipment developed for their efficient quantity production. H. H. Ashdown, in discussion, comments on the necessity for high-grade ingots and the control of forging temperatures. WLC(12d)

Extruding (12f)

Modern Extrusion Presses for Tubes, Rods, and Sections. *Metal Industry*, London, Vol. 38, Mar. 6, 1931, pages 271–272.

Description of new extrusion presses made by Krupp Grusonwerk of Magdeburg. Modern presses are arranged to operate according to 2 working processes: (1) Direct—best for extruding wide strip and thin wire, (2) Inverted—which requires lower extrusion pressure and lower amount of discard of billet. Modern presses have head plate and cylinder made in a single steel casting, doing away with tie columns and nuts. PRK(12f)

The Influence of Pressure and Temperature on the Extrusion of Metals. C. E. PEARSON & J. A. SMYTHE (Armstrong College). *Institute of Metals, Advance Copy* No. 558, 1931, 25 pages; *Metal Industry*, London, Vol. 38, Mar. 20, 1931, pages 311–314; Mar. 27, 1931, pages 339–342; Apr. 3, 1931, pages 361–362; Apr. 17, 1931, page 410.

In the direct extrusion process a force is applied at one end of a billet to force the metal through a die at the opposite end, while in the inverted process the force is applied through the die. For a given temperature and rate of extrusion the inverted process requires only about one-half the power required for the other process. Extrusion was studied in a small press by extruding Pb, Bi, Cd and Sn. Determination of the flow in Bi showed that in the direct process the entire billet was worked, while in the other process only the portions adjacent to the die were worked. With a lubricant between the billet and wall the power required in the direct process is greatly decreased. The dependence of rate of extrusion on the pressure and temperature is determined for the several metals. 8 references. PRK + JLG(12f)

Machining (12g)

Factors Affecting Machinability of Malleable Cast Iron. H. A. SCHWARTZ. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, July 1930, pages 210–258.

Machinability of malleable cast iron was determined by measuring the torque and thrust of a drill advancing at constant speed, and the feed and torque of a drill advancing under constant pressure. Machinability is largely determined by the carbon content of the iron. CHL(12g)

Design and Construction of Hot Saws for Cutting Heavy Sections. A. B. PEARSON (Carnegie Steel Co.). *Iron Age*, Vol. 126, Oct. 30, 1930, pages 1226–1228, 1277–1278; *Rolling Mill Journal*, Vol. 4, Dec. 1930, pages 683–687.

Includes discussion. Abstract of paper read before the Iron & Steel Division of the American Society of Mechanical Engineers at Chicago, Sept. 1930. Describes saws for cutting hot and cold metals and gives results of tests on a variety of saws. MS + VSP(12g)

Torque, Thrust and Power for Drilling. O. W. Boston & C. J. Oxford. *S. A. E. Journal*, Vol. 28, Mar. 1931, pages 378–383.

Tests on drilling various grades of steel and cast iron were conducted in a specially equipped drilling press at the University of Michigan and reported in detail in a previous paper. The present paper is an extension of the results of these tests in formulas, tables and charts for determining the thrust, torque and horsepower that will be required in practice for drilling with drills of 1½ in. or smaller diameter in the various materials that were tested, which were representative of those commonly used in industry. (12g)

Hard Metal Carbides and Cemented Tungsten Carbide. Samuel L. Hoyt (General Electric Co.). *Transactions, American Institute of Mining & Metallurgical Engineers, Institute of Metals Division*, 1930, pages 9–58.

Lecture at New York meeting, Feb. 1930. The literature on hard metal carbides is reviewed. Commercial cemented tungsten carbide is made by mixing WC with Co powder and sintering. The WC is prepared by heating W powder in H together with C. The Co powder is prepared by H reduction. The 2 powders are mixed in a ball mill. Micrographs show the structures of the products. The Vicker's Brinell hardness is as high as 1450, and the density is as high as 15. Graphs showing the high cutting efficiency of the cemented carbide are presented. Contains 45 references. JLG(12g)

Drawing & Stamping (12h)

The World's Wire Drawing Practice. K. B. Lewis. *Wire & Wire Products*, Vol. 5, July 1930, pages 265–266, 285–288; Aug. 1930, pages 306–307, 327–330.

The methods of wire drawing in Europe, Canada and Mexico are outlined. GN(12h)

Recent Development in Wire Drawing and Forming Machinery. C. S. Arms. *Wire & Wire Products*, Vol. 5, July 1930, pages 267, 288–289.

General discussion. GN(12h)

Die Lubricants and Lubrication. R. T. Kline. *Wire & Wire Products*, Vol. 5, Dec. 1930, pages 466–467.

The proper lubricant for wire drawing is determined by wire, die and drawing speeds. GN(12h)

Studies of the Wire-Drawing Process. I. The Application of Photo-Elastic Methods to the Problem of Wire-Drawing Stresses. F. C. Thompson & J. Barton. *Carnegie Scholarship Memoirs, Iron & Steel Institute*, Vol. 19, 1930, pages 39–78.

Paper received Sept. 6, 1929, contains 6 references. Photo-elastic study by the method evolved by Coker maps of the stresses in isotropic celluloid strips drawn between dies was made. Certain differences were noted due to the shape of dies and the experimental technique is not strictly analogous to wire drawing. The results reported are of a preliminary nature and form the ground work for further study of wire drawing. WLC(12h)

Forming Properties of Thin Sheets of Some Nonferrous Metals. W. A. Straw, M. D. Helfrick & C. R. Fischrupp (Western Electric Co.). *Technical Publication* No. 406, *American Institute Mining & Metallurgical Engineers*, 1931, 14 pages.

The smallest radii on which various commercial brasses, bronzes and nickel-silver sheets can be bent in a punch press were determined. Sheets of several hardnesses were used. Strips ¾ in. wide were formed with a 90° V die and 90° wedge shaped punches; the punches being made with the edges ground to various radii. Tables are given indicating the radii over which the various alloys, in various thicknesses and tempers can be bent without cracking. As examples a ½ hard 65–35 brass can be formed with a sharp punch at gages from 20 to 11, while the hard sheet can be formed in this manner only when thinner than 15 gage. With this alloy and temper a 15 gage sheet requires at least a 0.0156 in. radius, and an 11 gage sheet requires at least a 0.0937 in. radius. JLG(12h)

Metallurgy of the Modern Die Set. John H. Hruska. *Iron Age*, Vol. 127, Feb. 26, 1931, pages 702–705.

Castings for die sets are made almost exclusively from semi-steel or a special grade of gray cast Fe. Heat treatment of die set castings. Increased temperature decreases hardness, prolonged heating enlarges graphite flakes of matrix and decreases transverse strength. Leader pins and bushings are made of pearlitic Mn steels. Box carburizing is desirable in case of long leader pins and bushings. Rotary furnace has certain outstanding features so far as quick production and low cost is concerned. Drawing may be done in rotary furnaces, salt pots or oil tanks with accurate temperature regulation. Results of analyses are tabulated. VSP(12h)

Causes of Internal Stress and Season Cracking in Drawn Brass Tubes. D. K. Crampton (Chase Brass & Copper Co.). *Metal Stampings*, Vol. 3, May 1930, pages 453–456, 462.

From a paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, June 1930, page 568. MS(12h)

Wire Making Practice in the United Kingdom. A. C. Blackall. *Wire & Wire Products*, Vol. 5, June 1930, pages 210–211, 297–298.

The article describes British methods of annealing, pickling, cleaning and pointing and the correspondent types of machinery. GN(12h)

Hardness Tests of Steel Sheets Aid Production Results. W. H. Graves (Packard Motor Car Co.). *Iron Trade Review*, Vol. 86, Mar. 27, 1930, pages 59–60.

From a paper read before the American Society for Testing Materials in Detroit, Mar. 19, 1930. See "Sheet Steels for Automobiles," *Metals & Alloys*, Vol. 1, July 1930, page 633. MS(12h)

Hard Metal Substitutes for Diamonds. A. Ackermann. *Wire & Wire Products*, Vol. 5, Nov. 1930, pages 430, 437, 438.

Discussion of composition and advantages of various German hard metals for wire drawing dies. Description of the preparation of dies and special lubricants, precautions in drawing copper wire. GN(12h)

Pickling (12i)

Metalware Pickling Data. Wallace G. Imhoff. *American Metal Market*, Vol. 38, Mar. 20, 1931, pages 5, 10; Mar. 21, 1931, page 5; Mar. 24, 1931, pages 5, 10.

Data are included in 28 tables and show the results obtained in a number of plants on the pickling of hot galvanizing of 12 qt. light water pails. The weights of zinc deposited differed by 19⅛ lbs. per gross deposited as coating. WHB(12i)

Cold Working (12j)

Principles of Cold Up-setting and the Limitations. S. Hillman. *Metal Progress*, Vol. 1, Oct. 1930, pages 58–59.

Brief discussion. WHK(12j)

The Cold Rolling of Strip Steel. Stephen Badlam. *Yearbook American Iron & Steel Institute*, 1930, pages 352–444.

Includes discussion. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 44. (12j)

Surface Compression. (Das Drücken der Oberfläche.) Hilmar Döring. *Metallwirtschaft*, Vol. 9, Aug. 22, 1930, pages 702–706.

Contains 5 references. Bronze, Cu, Al alloys, cast iron, carbon and alloy steels were cold worked on the surface in a specially constructed press. The endurance limit was raised 8–11% by the cold working in every case except cast iron, in which no change took place. It was not determined whether a greater increase is possible. In some instances the cold working caused small internal cracks at inclusions. Surface irregularities can be overcome by cold working. CEM(12j)

Cleaning (12k)

Effect of Impurities in Cleaning and Finishing Materials. R. F. Cohn. *Metal Cleaning & Finishing*, Vol. 2, Feb. 1930, pages 103–106.

Impurities may exert beneficial effects as well as detrimental. Gives some specific examples. Ordinary impurities in H_2SO_4 for pickling have no significance. However, As renders the acid useless for pickling. Cheaper soaps, with fillers and a small amount of free alkali, are better cleaners than "pure" soaps. Electroplated finishes are more satisfactory if proper attention is paid to the purity of chemicals used and the purity of the deposit. Extremely pure Zn is hardly attacked by 10% HCl, which dissolves commercial high grade Zn almost at once, and dissolves 53% of the weight of C. P. Zn in the same time. On the other hand in HNO_3, the extremely pure Zn dissolves completely, the C. P. Zn loses half its weight, and the commercial high grade metal loses only one-third its weight. MS(12k)

Polishing & Grinding (12l)

Fifty-seven Foot Grinding Machine Believed to Be Largest of Its Kind. *Grits & Grinds* (Norton Company), Vol. 21, Dec. 1930, pages 8–10.

Description of machine that will grind cylindrical work up to 36-in. diam. and 288-in. length weighing up to 40,000 lb., easily within 0.0005 in. for concentricity and straightness. In a trial it removed stock from a cast iron column at rate of 6 cu. in. per minute. MFB(12l)

Flying and Grinding. H. J. Griffing. *Grits & Grinds* (Norton Company), Vol. 21, Dec. 1930, pages 1–8.

Grinding problems in the production of aeronautical engines; machines and special fixtures, etc. MFB(12l)

DEFECTS (13)

Deep Etching of Brass. W. F. Graham & L. A. Meisse. *Transactions & Bulletin American Foundrymen's Association*, Feb. 1931, pages 810–825.

Deep etching of brass with a solution of nitric acid (1.42 specific gravity) and 10% by volume of hydrochloric acid (1.18 specific gravity) clearly brings out areas of discontinuity of the structure caused by sonims, crystal boundaries or dendrites. CHL(13)

Non-Metallic Inclusions in Metals. G. F. Comstock. *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 348–354, 8 figures.

Brief general discussion. Wohrman's modification of the methods outlined by Campbell and Comstock for identification of inclusions is reproduced. A few micrographs of typical inclusions are given. HWG(13)

A New Type of Inclusion in Cast Iron and its Relation to Manganese and Silicon Content. F. J. Cook. *American Foundrymen's Association, Preprint* No. 31–14, 1931, 12 pages.

Glassy inclusions, heretofore not described, appear in cast iron when the Mn is within 0.4% of the Si content. They do not affect the wearing qualities of the iron. Believed though not definitely proven to be manganese silicate inclusions. CHL(13)

Origin and Effect of Inclusions in Steel. B. M. Larsen. *Metals & Alloys*, Vol. 1, Sept. 1930, pages 703–713; Oct. 1930, pages 763–769; Nov. 1930, pages 819–825.

A review. ESC(13)

Inclusions and Their Effect on Impact Strength of Steel. A. B. Kinzel & Walter Crafts (Union Carbide and Carbon Research Labs.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 402, 1931, 33 pages.

The sizes and quantities of inclusions in several Ni and Cr-V steels were determined from micrographs of carefully polished sections. Inclusions having a diameter above 0.005 mm. were counted. The number of inclusions per mm.^{2} varied from 44 to 96. Tensile impact tests were made on the same steels normalized. The samples were cut both from the center and from an intermediate zone. The dynamic strengths of the steels decreased as the inclusions increased, and curves are given to show the exact relationship between quantity of visible inclusions and dynamic properties. The magnitude of the effect of the inclusions increases as the hardness of the steels increases. "Body" is influenced by inclusions smaller than 0.005 mm. Inclusions were obtained as residues and analyzed. The quantity of inclusions was directly proportional to the oxide-manganese sulphide ratio of the residues. JLG(13)

Non-Metallic Inclusions in Iron and Steel. (Nichtmetallische Einschlüsse in Eisen und Stahl). A. Bajkoff (Institut für Metallkunde, Russia). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 355–362.

General discussion with micrographs. HWG(13)

The Occurrence of Fractures in Hard Soldering Steel (Das Auftreten von Brüchen beim Hartlöten von Stahl). *Stahl und Eisen*, Vol. 50, Oct. 2, 1930, pages 1403–1405.

Correspondence between W. Albert and W. Riede on Riede's paper on the above subject in *Stahl und Eisen*, Vol. 49, 1929, pages 1161–1162. GN(13)

Failures of Cast-iron Kettles in Lead Refining. Carl E. Swartz (American Smelting and Refining Co.). *Technical Publication* No. 389, *American Institute Mining & Metallurgical Engineers*, 1931, 13 pages.

Data were obtained on 5 kettles whose life ranged from 11 to 1180 heats. The kettles with a long life had a gray fracture, while less satisfactory ones had a black fracture. Rapid failure is frequently due to overheating or to non-uniform heating. In some cases temper carbon had been formed near the fracture. In most cases the pearlite had been divorced in the heated portions of the kettle. Fire cracks that originated in graphite flakes were observed. JLG(13)

Diagnosis of an Interesting Mechanical Failure. Gordon Sproule. *Canadian Foundryman*, Vol. 22, Feb. 1931, page 10.

The author, after discussing the fundamentals of crystalline structure, deals with the failure of the tapered pinion seat of a motor armature shaft, the keyway of which, after having been worn in service, was filled by adding metal by welding. The effect of applying the coatings of metal was such as to cause the ultimate failure of the shaft. A criticism of the methods adopted is given. OWE(13)

Hair Line Cracks. T. M. Service. *Royal Technical College Metallurgical Club Journal*, Glasgow, No. 7, 1929–1930, pages 9–15, 17 references.

Chiefly a discussion of the work and opinions of others. In the author's work on 49 forgings of approximately 0.27% C, 3.60% Ni, 0.70% Cr, 0.50% Mn, those forgings allowed to become cold, and then reheated above Ac_3 showed hair cracks; those heated below Ac_1 did not. Service believes that the cracks are due to differential cooling stresses which do not appear as cracks till the stress is released, as by cutting off a disc. The cracks can be prevented by suitable control in annealing. HWG(13)

ECONOMIC (16)

Engineering Markets of the World. VI. A. J. LIVERSEDGE. *Engineering*, Vol. 130, Nov. 14, 1930, pages 609–610.

Discusses the trade situation of Canada. In 1929–30, Canada imported only 6.8% of its iron and steel and their products from the United Kingdom, while 89% was imported from the U. S. Curves are given showing Canada's engineering imports from 1913 to 1930 incl. from the United Kingdom and elsewhere. For the former, all curves except one end on lower levels than where they began. For cast, forged and rolling mill products, the figures for 1930 are practically the same as for 1913. Preference given to goods from the United Kingdom does not counterbalance the geographical advantage enjoyed by America. Gives table summarizing engineering imports into British Dominions overseas. Briefly discusses trade situation of the United Kingdom and its lesser Dominions, Crown Colonies, and Protectorates. LFM(16)

Secondary Metals in 1929. J. P. DUNLOP. *Mineral Resources of the United States*, 1929, Part 1, Feb. 24, 1931, *United States Bureau of Mines*, pages 179–201.

The quantity of secondary metals recovered in 1929 (as reported) increased 7% over 1928, and amounted to over 1,000,000 tons. There were small decreases in the output of Sn, Ni, Zn and Sb, small gains for Pb and Al and large gains in the output of Cu. Pt recovery was 42,759 oz. (28% of imports), and 13,072 oz. less than 1928. Au and Ag recovery amounted to over $29,000,000. Detailed figures are given. 23 footnotes and textual references. AHE(16)

Northern British Columbia and Yukon in 1930. W. E. COCKFIELD. *Canadian Mining Journal*, Vol. 52, Feb. 6, 1931, pages 138–143.

Promising placer developments in Atkin and Big Salmon districts are noted. Mayo silver reserves were reduced due to the slump in prices. WHB(16)

German Electrolytic Industries. (Les industries electrolytiques de l'Allemagne.) V. ENGELHARDT. *Journal du Four Electrique*, Vol. 40, Jan. 1931, pages 16–20.

A brief survey of German electrolytic industries giving the achievements of each branch. JDG(16)

Gold—Its Geographical Distribution and Geological Occurrence. J. MACKINTOSH BELL. *Canadian Mining Journal*, Vol. 52, Mar. 6, 1931, pages 246–251.

An address covering the world's gold fields. It seems probable that the annual production of gold will decrease 20–25% during the next decade. WHB(16)

The Marketing of Nickel. J. W. FURNESS. *Trade Information Bulletin* No. 685, 1930, *United States Department of Commerce, Bureau of Foreign and Domestic Commerce*, 31 pages.

The following subjects are discussed: mode of occurrence, minerals, properties, metallurgy, uses (Ni-Ag, Ni-Fe alloys, Cu-Ni alloys, bronzes, structural Ni-steel, Ni-steel castings, corrosion-resistant steels, Ni cast iron, malleable Ni, coinage, plating, catalyzers, battery plates, heat-resisting electrical alloys, salts, etc.), world production and imports, present day sources, potential resources, and marketing. Over 100 references are given. AHE(16)

Arsenic in 1929. V. C. HEIKES. *Mineral Resources of the United States*, 1929, Part 1, Aug. 29, 1930, *United States Bureau of Mines*, pages 1–4.

Production of arsenious oxide in the United States in 1929 amounted to 16,605 short tons of which 11,071 tons was refined. All the output was a by-product from smelting Cu and Pb ores. AHE(16)

Lead in 1929. ELMER W. PEHRSON. *Mineral Resources of the United States*, 1929, Part 1, Mar. 7, 1931, *United States Bureau of Mines*, pages 231–264.

In 1929, 672,498 short tons of primary Pb was produced from domestic ores (a 7% increase over 1928), and 102,135 tons from foreign ores and base bullion (a 34% decrease from 1928), a net decrease of about 1%. Secondary Pb recovery was 311,000 tons (308,600 in 1928), 46% of the primary Pb from domestic ores. Total Pb consumption passed all previous records, amounting to 945,200 tons, 2% increase over 1928 and 12% over 1927. Storage batteries took 22.2%, cable coverings 21.8%, white lead 12.5% and building 10.2%. Consumption in batteries and white lead decreased 5 and 4% respectively, while use for cable coverings increased 14%. Domestic mine production increased 3%, being shared generally by all districts. General imports in base bullion decreased 35%; in ore and matte they increased 21%. Exports declined. World smelter production amounted to 1,971,000 tons, an increase of 6% over 1928. Production from all but 2 of the 13 countries producing 1% or more of world's Pb was increased over 1928. AHE(16)

Systematic Recording of Operations in Iron Works and Rolling Mills as an Aid to Economy in Management and as a Basis for the Correct Estimation of Production Costs. (Planmässige Betriebsaufschreibung in Hütten- und Walzwerken als Hilfsmittel wirtschaftlicher Arbeitsführung und Grundlage richtiger Selbst-Kostenermittlung). R. AMMON. *Archiv für Eisenhüttenwesen*, Vol. 4, Sept. 1930, pages 161–167.

Report 45 of the Committee of Plant Economy of the Verein deutscher Eisenhüttenleute. General discussion of the economy which can be achieved in large steel plants by detailed recording of the production. A "standard" example is given for a rolling mill. GN(16)

The Nickel Industry. *Canadian Mining Journal*, Vol. 52, Jan. 30, 1931, pages 22–24.

An official review of the enlarged mine and smelter facilities and of the expanding markets for nickel and its alloys. WHB(16)

Progress in the Iron and Steel Industry in 1929. Report of the Executive Committee of the Iron and Steel Division. *Transactions American Society Mechanical Engineers*, Vol. 52, Jan.–Apr. 1930, pages 1–3.

This gives the progress made by the iron and steel industry in 1929. Some of the subjects discussed include Fe ore, coal, coke, blast furnaces, rolling mills, pipe, wrought Fe, alloy steels, nitriding, centrifugal casting and foreign patents. (16)

The Empire's Zinc Resources II. *Canadian Mining Journal*, Vol. 52, Feb. 20, 1931, pages 201–204.

Australia is the largest producer, while the Canadian output is increasing rapidly. Rhodesia has important resources. The mining areas are briefly discussed. WHB(16)

Lead. G. W. THOMPSON (National Lead Co.). *American Metal Market*, Vol. 38, Feb. 20, 1931, pages 3, 5, 10.

The great increase in consumption of Pb has been in the electrical industry, chiefly for cable coverings. The problem in the future of the Pb and Cu industries will depend largely upon the demand by this industry. Properties of lead and its alloys with Sb and Sn are touched upon. WHB(16)

Platinum. PAUL M. TYLER & R. M. SANTMYERS. *Bureau of Mines Information Circular* 6389, Feb. 1931, 69 pages.

The following subjects are discussed for platinum: properties, uses, alloys, substitutes, history, ores and minerals, occurrence (United States and foreign, by states and countries), assaying, mining, concentrating, refining, production, marketing and prices. Osmiridium is briefly discussed. AHE(16)

Is Electric Heat Economical? WIRT S. SCOTT (Westinghouse Elec. & Mfg. Co.). *Electric World*, Vol. 96, Aug. 2, 1930, page 213.

The economies of electric heat are outlined. Complete factory costs are tabulated for 5 heat-treating plants. The costs are compared with fuel-fired equipments of similar capacity. WHB(16)

PLANTS & LABORATORIES (17)

The British Empire's Largest Copper Refinery. C. H. ALDRICH & J. K. BRYAN (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1930, pages 489–492.

A general description of the new copper refinery of the Ontario Refining Co., Ltd., at Copper Cliff. The initial capacity is 120,000 tons per annum, and blister copper from the Port Colborne refinery of the International Nickel Co. and from other Canadian plants are refined. WHB(17)

A Modern Electric Steel Plant (Ein neuzeitliches Elektro-Stahlwerk). K. KERPELY. *Giesserei-Zeitung*, Vol. 27, Feb. 15, 1930, pages 101–102.

Description of a new plant in Campia Turzii, Roumania, for the production of Fe and steel wire and wire products of all kinds. Reasons are given for the installation of an electric furnace which is 3-phase arc type with a capacity of 1 to 1.5 tons and is equipped with 500 kva. 3-phase oil transformer with automatic hydraulic electrode regulation of the system. (17)

Cooperative Research. O. W. ELLIS. *Metal Progress*, Vol. 1, Oct. 1930, pages 85–87.

A descriptive account of the metallurgical laboratories of the Ontario Research Foundation. WHK(17)

Employs Semi-Continuous Methods for Rolling Auto Sheets. JOHN D. KNOX. *Iron Trade Review*, Vol. 86, May 1, 1930, pages 119–122.

Description of the plant and practice of the Newton Steel Co., Monroe, Mich. Roughing and finishing mills are installed in separate trains, thus eliminating back-tracking. Each finishing mill has an individual pack furnace, the packs being heated to 1350–1375° F. Some of the sheets are normalized in oil-fired furnaces. Annealing is done in producer-gas fired, box-type furnaces. MS(17)

Heat-Treats Taps and Dies Electrically. F. A. WESTBROOK. *Industrial Record*, Dec. 1930, pages 22, 54, 56.

Description of equipment at plant of Winter Brothers, Wrentham, Mass., manufacturers of taps and dies. Electrically heated furnaces include a drawing oven, a box-type furnace for general use at 1600° to 1800°F., 5 pot furnaces of different sizes, and a high-temperature box-type furnace for hardening high-speed steel. Automatic temperature control is featured. Special interest attaches to furnace for hardening high-speed steel: heat treating by diamond block method—parts to be hardened placed in slotted holes in blocks of carbonaceous compound which are kept in the furnace all the time. Very efficient from production standpoint, one workman frequently obtaining production of 6000 taps/day. Blocks last for 3 days. Spoilage is zero. MFB(17)

Reversing Mill at Tata Iron & Steel Co. J. M. WILLIAMS (Westinghouse Electric & Mfg. Co.). *Blast Furnace & Steel Plant*, Vol. 18, July 1930, pages 1123–1125.

Illustrated description of the electrical equipment for driving the 35-in. reversing mill at Jamshedpur, India. MS(17)

The Merchant Mill of the Peine Works after Reconstruction. (Das Feineisenwalzwerk des Peiner Walzwerkes nach dem Umbau.) ERICH WOLFF. *Stahl und Eisen*, Vol. 51, Jan. 1, 1931, pages 8–10.

The reconstruction of the mill was undertaken in order to increase its capacity. The mill now has 3 high roughing stands, 2 intermediate stands and 7 finishing stands. The cooling bed was completely changed so that it can be simultaneously served from 2 lines. GN(17)

British and Continental Open-Hearth Steel Works—A Comparison. H. C. WOOD. *Iron Age*, Vol. 126, Nov. 6, 1930, pages 1299–1302; *Engineer*, Vol. 150, Oct. 3, 1930, pages 360–362.

Paper read at Prague meeting of the Iron and Steel Institute. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 14. VSP+LFM(17)

New Mills of the Gulf States Steel Co. WARREN WORTHINGTON. *Blast Furnace & Steel Plant*, Vol. 18, Jan. 1930, pages 93.

Describes new blooming-mill and plate-mill. MS(17)

To Study Special Steels in New Research Laboratory. GEORGE J. COMSTOCK. *Iron Age*, Vol. 126, Sept. 11, 1930, pages 686–687.

Describes an addition to the research laboratory of the Firth-Sterling Steel Co., McKeesport, Pa. VSP(17)

A Twelve Hundred Acre Airplane Project. C. A. VAN DUSEN AND OTHERS (Glenn L. Martin Co.). *American Machinist*, Vol. 73, Nov. 27, 1930, pages 837–865.

Description of the plant of the Glenn L. Martin Co. of Baltimore, Md. Discusses plant location, management, products, testing, plating, machinery, welding, tools, inspection, material handling, and a summary of equipment by departments. RHP(17)

Working Conditions Feature Layout of New Tool Plant. BURNHAM FINNEY. *Iron Age*, Vol. 126, Sept. 25, 1930, pages 849–853, 903–904.

Describes the new plant of Goddard & Goddard Co., Inc., Detroit. VSP(17)

Buys Strip for Steel Beds on Basis of Die Performance. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, May 8, 1930, pages 47–51.

Describes equipment and methods used in fabricating beds in the plants of the Simmons Co. Make welded tubes from cold-rolled strip steel. MS(17)

Forging Business Grows Under Alert Direction. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, March 13, 1930, pages 51–55.

Describes practice of the Camden Forge Co., Camden, N. J., which specializes in locomotive and marine forgings. Various parts are being nitrided. Steel used contains 0.32% C, 0.40–0.70% Mn, 0.20–0.30% Si, 1.00–1.25% Al, 1.50–1.75% Cr, 0.15–0.25% Mo, 0.03% and less S and P. When Cr is omitted, Al and Mo are raised to 1.5% and 1.0% respectively. The piece receives several heat treatments to remove all internal strains, before nitriding. The latter operation is carried out with NH_3 at a pressure of $1^1/_2$ in. H_2O in a Pb-sealed box. Temperature of nitriding is 950–1200° F., and duration of the process is 24–90 hrs. depending upon the depth and hardness of the case desired. MS(17)

Heat Treats Alloy Steel Side Frames. H. R. SIMONDS. *Steel*, Vol. 87, July 3, 1930, pages 51–53.

Describes practice of the Parish Pressed Steel Co., Reading, Pa., in the manufacture and treatment of side frames for trucks and busses. Frames are formed from a steel containing 0.23% C, 0.46% Mn, 0.05[sic]% Cr and 1.48% Ni; a Mn steel with 0.30% C and 1.52% Mn; or a C steel with 0.28% C and 0.45% Mn. Heat treating is done on a production basis. Use 40-ft. furnaces. MS(17)

Steel Foundry Reduces Cost of Cleaning Castings. H. R. SIMONDS. *Iron Trade Review*, Vol. 86, May 1, 1930, pages 114–118.

Eastern Steel Castings, Inc., Newark, N. J. has cut its cleaning costs more than one half by the installation of conveyors and new equipment and the adoption of piece rate and bonus system of compensation. Describes methods and equipment. MS(17)

The New Foundry of the Skoda Company. (Die neue Metallgiesserei der Aktiengesellschaft, vorm. Skoda Werke, Pilsen.) J. MEHRTENS. *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, pages 304–307.

The Skoda Company's up-to-date foundry for non-ferrous metals and alloys is described and various views of the interior presented. EF(17)

Smelting at Coniston in Blast Furnaces. W. A. MacDonnell & J. F. Robertson (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1931, pages 478–479.

With the present improved smelting operations the monthly capacity of the Coniston plant of the International Nickel Co. is 75,000 tons of ore per month. WHB(17)

Automatic Zinc Plating and Enameling Pipe. *Metal Industry*, New York, Vol. 29, Mar. 1931, pages 113–115.

A description of a modern conduit pipe coating installation of Steel & Tubes, Inc., Warren, Ohio. There are produced, under the supervision of one man, 100 ft./min. of pipe with zinc electro deposited on outside and a baked enameled coat on inside. All is done in 17 operations which involve alkali soak, alkaline electrolytic cleaner, acid pickle and dip, zinc cyanide "strike," zinc sulphate "finish," enamel spraying and baking. PRK(17)

Pipe Zinc Plated and Enameled Automatically. *Brass World*, Vol. 27, Mar. 1931, pages 65–69.

A description of the plant of Steel & Tubes, Inc., at Warren, Ohio, where electrically welded conduit is produced. The machine's seventeen operations are listed. Cleaning, pickling, rinsing, galvanizing, enameling and baking are combined into a completely continuous process. WHB(17)

Steel Produced by Electric Furnaces in Modern Canadian Tube and Steel Plant Supersedes Older Methods. *Iron and Steel of Canada*, Vol. 14, Feb. 1931, pages 30–32.

An article describing the steel-melting installation of Canadian Tube and Steel Products, Limited, Montreal, Canada. OWE(17)

MACHINERY & SUPPLIES (18)

New German Wire Machinery. P. Fidrmuc. *Wire & Wire Products*, Vol. 5, Sept. 1930, pages 343–346, 365, 366.

Description of high-speed rope making and stranding machines with stationary spool carriers. GN(18)

Electric Equipment to Operate the Blast Furnace Skip Hoist. C. P. Hamilton (General Electric Co.). *Iron & Steel Engineer*, Vol. 8, Mar. 1931, pages 139–144.

A paper read before the Chicago District Section of the A. I. & S. E. E. Six general types of drives are considered and studies made of general operating conditions on the basis of reliability, maintenance, flexibility, power consumption, speed regulation and cost. Several figures and a brief discussion are included. WHB(18)

German Wire Mesh Machinery. P. Fidrmuc. *Wire & Wire Products*, Vol. 5, Dec. 1930, pages 462–463, 478.

The article describes a new type of mesh making machinery, recently put on the market by Emil Jager, Neustadt, Germany. GN(18)

Core Room Conveyors. D. B. Hill. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, July 1930, pages 273–288.

A description of mechanical installations for continuous baking and handling of cores. CHL(18)

Alternating Current Drives for Tube Mills and Reconstruction of a Strip Mill. (Drehstromantriebe von Rohrwalzwerken und Umbau einer Streifenstrasse.) W. Albrecht. *Stahl und Eisen*, Vol. 50, Oct. 16, 1931, pages 1457–1462.

Report 78 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The electric equipment and wiring diagram for driving the skew rolls of a tube rolling-mill are illustrated and described. The reconstruction of a strip mill, resulting in savings and increasing the capacity of the mill from 5.6 tons/hr. to 12 tons/hr., is also described. GN(18)

Roll Straightening Machine (Rollenrichtmaschinen für Walzwerkszurichterei). *Stahl und Eisen*, Vol. 50, Sept. 11, 1930, pages 1307–1308.

Illustrated description of a modern universal roll straightening machine built by A. Wirth & Co., Erkelenz, Germany. GN(18)

Device for Turning Forgings (Wendsvorrichtung für Schmiedestücke). *Stahl und Eisen*, Vol. 50, Aug. 28, 1930, pages 1234–1235.

Description of a simple device for turning bulky forgings, built by Deutsche Maschinenfabrik, Duisburg. GN(18)

Low Production of Hot Copper Rods without Loss of Economy. *Brass World*, Vol. 27, Mar. 1931, page 56.

A new type of hot mill for the production of copper rods at a rate well below that hitherto considered the economic minimum is manufactured by the United Engineering and Foundry Co., Pittsburgh, Pa. The layout is of the Belgian type consisting of roughing train, finishing train, reels, water bosh and the necessary tables and auxiliary. Profitable operation is possible with a production of no more than 10,000 lbs./hr. WHB(18)

BIBLIOGRAPHIES (19)

Recent Developments & Researches on Cast Iron. J. W. Donaldson. *Royal Technical College Metallurgical Club Journal*, Glasgow, No. 7, 1929–1930, pages 38–40, 8 references.

Brief listing of a few investigations published in 1927–1929. HWG(19)

Progress of the Knowledge Regarding Slag (Solid Non-Metallic) Inclusions in Iron and Steel. C. Benedicks & H. Löfquist (Metallographiska Institutet, Sweden). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 345–347, 29 references.

Lists important publications appearing since the report by the same authors in 1927. HWG(19)

MISCELLANEOUS (20)

Cleaning Stack Gases. John B. C. Kershaw. *Electrical World*, Vol. 97, Mar. 21, 1931, pages 542–546.

London power stations are washing the plant gases to eliminate dust and noxious gases. Three essentials to success for the treatment of flue gas are as follows: (1) the placing of sprays along the first flue to increase the humidity of the gases, with surfaces of iron to assist in converting SO_2 to SO_3, (2) the provision of further sprays and of wetted contact surfaces in the second flue to continue the conversion and to effect the solution of SO_3 and its elimination from the waste gases, and (3) the provision of further surfaces moistened with alkali for the total elimination of sulphur from the gas. The Battersea power station is planned to fulfil the conditions named. It permits the use of an over-all figure of 25 tons of water per ton of coal and the time of contact allowed for ranges from a minimum of 23 seconds to a maximum of 44 seconds. Corrugated plates of (a) staybrite, (b) calorized steel, (c) a silicon-aluminum alloy and (d) tinned iron are being tried out to secure the necessary catalytic action. A close-grain cast iron, or a silicon-cast iron will be used for all pipe work and an alloy of silicon and copper or of cast iron and monel metal will be used for the circulating pumps and other machinery in contact with the wash water, and sprays of the centrifugal type will be constructed of a silicon-copper alloy. Cost estimates for gas washing (36¢ per ton of coal burned) are considered high. Results of experimental trial of gas-washing plant at Grove Road Station of the London Power Co. in 1930 are tabulated. WHB(20)

REDUCTION METALLURGY (31)

Resistance of Iron Ores to Decrepitation and Mechanical Work. T. L. Joseph & E. P. Barrett (U. S. Bureau of Mines). *Transactions, American Institute of Mining & Metallurgical Engineers, Iron & Steel Division*, 1930, pages 365–377.

Includes bibliography of 53 references. The resistance of iron ores to decrepitation in a blast furnace was determined by screen analyses. The ores were samples, one portion rotated in a cold kiln for $1^1/_2$ hrs., and a second portion rotated in the kiln for the same time at 1400° F. The average decrease in particle size on cold working was 18%, and on the hot working 38.1%. Screen analyses on the raw ores do not indicate their propensity to form dust in the blast furnace, but the hot working tests do. Thirty odd ores, including Mn ores, were studied, and the results of the tests are given for each. Three samples of limestone were also studied. JLG(31)

Recovering Smelter Dust and Oxide. N. F. Kepner, W. Romanoff & C. O. Thieme. *Engineering & Mining Journal*, Vol. 131, Jan. 26, 1931, pages 60–64.

A brief description of the practice and equipment and technical control in the modern secondary-metal smelter of H. Kramer & Co., Chicago. The preparation of scrap for the smelting furnaces, and furnace operation are summarized. The dust collecting equipment is calculated to be of sufficient capacity to handle the gases and dust from 3 reverberatories or 2 furnaces and a 42-inch blast furnace operating simultaneously. Chrome-nickel-iron alloy flue branches and a manifold were necessary due to excessive temperatures. A spray chamber with water from a high-pressure pump was also necessary. A general layout of the flue system as far as the spray chamber illustrates the manner in which the branch flues lead to the manifold "A." Pyrometric control was found necessary to preserve the life of the high-temperature-resistant steel branches. WHB(31)

Suggested Improvements in Fire Refining of Copper. H. H. Alexander. *Engineering & Mining Journal*, Vol. 131, Mar. 9, 1931, pages 226–229.

An outline of methods incorporated in U. S. Patents 1,687,277, 1,756,967, and 1,776,826. Means of removing impurities by oxidation, the deoxidation of copper, and improved melting practice as tried out in the laboratory and in furnaces of commercial size are pointed out. Melting and refining simultaneously results in: low initial cost of equipment, lower slag production, few repairs, low operating cost and a better product. WHB(31)

Refining Nickel-Copper Matte at Port Colborne. R. L Peek. *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1931, pages 482–488.

A rather detailed description of the refining operations at the Port Colborne plant of the International Nickel Co. of Canada. WHB(31)

Effect of Particle Size on Flotation. A. W. Gaudin, John O. Groth & H. B. Henderson (Montana School of Mines). *Technical Publication* No. 414, *American Institute of Mining & Metallurgical Engineers*, 1931, 23 pages.

To determine the effect of particle size concentrates were obtained from several mills and samples were prepared by grinding minerals. There was found to be a time sequence with regard to particle size; the medium coarse particles floating first. No successful method of floating very fine pulp was found. Recovery is optimum in a well-defined range, and selection is optimum in another well defined range. In the mill concentrates the size for optimum recovery was between 280 and 560 mesh. 11 references. JLG(31)

Method and Cost of Recovering Quicksilver from Low-Grade Ore at the Reduction Plant of the Sulphur Bank Syndicate, Clearlake, California. Worthen Bradley. *Bureau of Mines Information Circular* 6429, 1931, 17 pages.

The ore deposit consists of grains of cinnabar finely disseminated throughout a gangue composed principally of altered basalt with subordinate amounts of elemental S (1–15%, average 2%) and opal. Recovery is as follows: (1) screening (cinnabar mostly in fines) and sorting the low-grade ore to obtain a furnace feed containing 8–10 lbs. of Hg per ton, (2) treatment in a rotary kiln, (3) precipitation of dust from gas stream, (4) condensing Hg from gas, (5) flotation of low-grade condenser mud, and (6) retorting high grade condenser mud and high-grade flotation concentrates. Costs per ton of ore treated for April 1930, are: screening and sorting $0.835, furnace treatment 1.709, flotation 0.387, retorting 0.177, assaying 0.107, condensing 0.534, miscellaneous 0.359, and total $4.108. AHE(31)

Flotation of Minor Gold in Large-Scale Copper Concentrators. E. S. Leaver & J. A. Woolf (U. S. Bureau of Mines). *Technical Publication* No. 410, *American Institute of Mining & Metallurgical Engineers*, 1931, 32 pages.

Ores from several mines were tested. The Au is usually included in the pyrite. The Au can be floated and the pyrite depressed with lime. Lime depresses the Au if the alkalinity is above 10 pH. An alkalinity of 7.5 to 10 was found desirable. Ores with a low ratio of pyrite to copper sulphide and with Au under $1 a ton gave a 25% Cu concentrate containing over 90% of the Cu and over 80% of the Au. Contains 2 references. JLG(31)

Arsenic Elimination in the Reverberatory Refining of Native Copper. C. T. Eddy (Michigan College of Mining and Technology). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 403, 1931, 16 pages.

The effect of As on the electrical conductivity of Lake Cu was determined. A study was made of the soda-ash method for the removal of As. In this process As can be most economically removed at an oxygen concentration of 0.85%. 7 references. JLG(31)

Reactions between Iron Sulfide, Sulfur Dioxide, and Iron Oxides in the Metallurgy of Copper. A. C. Halferdahl. *Industrial & Engineering Chemistry*, Vol. 22, Sept. 1930, pages 956–963.

41 references. Data and calculations are presented which indicate that magnetite is readily formed in smelting operations. Once formed, its reduction to ferrous oxide by ferrous sulphide required temperatures of 1300° C. or higher. A modification of present methods for treating copper converter slag in reverberatory furnaces is suggested. The function of coke in pyritic and semi-pyritic copper smelting is defined in a somewhat different manner than hitherto. MEH(31)

The Modern Blast Furnace and its Operation. Part 4. Chemical Principles. R. A. Hacking. *Metallurgia*, Vol. 3, Nov. 1930, pages 27–28.

Chemistry of the blast furnace process. JLG(31)

Experimental Flotation of Oxidized Silver Ores. H. S. Gieser (Tigre Mining Co.). *Technical Publication* No. 401, *American Institute Mining & Metallurgical Engineers*, 1931, 9 pages.

Reagents required for the flotation of an oxidized sulphide ore were determined. Aerofloat 25 and ethyl xanthate worked fairly well. The efficiencies for 64 organic compounds are listed. 2 references. JLG(31)

Statistics on the Swedish Iron Industry during Recent Years. (Nagra statistiska data fran var jernhantering under de senaste aren.) Arvid Johansson. *Jernkontorets Annaler*, Vol. 114, Dec. 15, 1930, pages 623–634.

Consumption of charcoal decreased from 2.72 million cu. meter in 1924 to 1.98 million cu. meter in 1929. Production of Fe ore remained sensibly constant at 550,000 to 670,000 tons. The value of the export was 8.5% of the total value of all exports, and the value of imports 4.9% of the total. HCD(31)

The Metallic Precipitation of Zirconium. Howard S. Gable. *Journal American Chemical Society*, Vol. 52, Sept. 1930, page 3741.

A methyl alcohol solution of zirconium sulphate is treated with zinc; hydrogen is liberated and Zr deposits. MEH(31)

Treatment of Low-Grade Ores of Lead, Zinc and Tin. *Metallurgist*, Sept. 1930, pages 133–134.

The process developed in Germany for the utilization of low-grade ores of lead, zinc and tin is described. It is termed the "Wälzverfahren" or the "roll-over" process. The "rolling-over" occurs as the charge of ore with suitable admixtures, consisting chiefly of coke, passes down a long inclined rotary tube furnace of large dimensions, this rolling over bringing about an intimate mixture and continued disintegration of the material, which is said to determine the efficiency of the extraction. The extraction itself, however, takes place by volatilization and the production of an oxide or sulphide fume which is drawn from the furnace into condensing plant, in which it is recovered by one of the well-known methods, such as the electrical deposition after the manner of the Lodge-Cotterill process, or in bag filters, etc. The process has come into use in old-established districts in Germany where the ore is very low grade. A comprehensive account of the process in its recent state of development, together with references to still more detailed literature is to be found in an article by R. Hoffmann in the *Zeitschrift Verein deutscher Ingenieure*, Vol. 14, July 26, 1930, pages 1041–1048; see abstract in *Metals & Alloys*, Vol. 2, Jan. 1931, page 20. VVK(31)

Progress in the Development of the Wiluna Mine, W. A. *Chemical Engineering & Mining Review*, Vol. 23, Jan. 5, 1931, pages 136–139.

An illustrated description of this mine indicates the simplicity of the whole equipment and the very compact layout. The plant is the best laid out and best equipped gold mining unit in Australia. Ore treatment will comprise concentrating by flotation of the gold-bearing sulphides in a product 8–10% by weight of the original ore, roasting the flotation concentrate, and cyaniding the roasting calcine. A gyratory and two Symons cone crushers will crush the ore in two stages, to $^1/_2$ inch size. Hardinge conical ball mills followed by Ruwolt tube mills will operate in the fine-grinding section. Dorr bowl and rake classifiers will accomplish the classification. Before flotation, the ground pulp will be thickened in Dorr traction-type thickeners. In the flotation plant, power machines will be used for scavenging the tail and pneumatic machines to produce a clean concentrate. The flotation concentrate after thickening, will be filtered by Oliver continuous filters, dried on Lowden dryers, and roasted in Edwards-type roasters. Gold will be precipitated by the Merrill-Crowe vacuum. Pulp and water circuits will have Wilfley sand-type pumps. WHB(31)

Investigation on the Reduction Processes of Iron Ore. III. (Undersökning av förloppet vid reduktion av Järnmalm.) BERTIL STÅLHANE & TORE MALMBERG. *Jernkontorets Annaler*, Vol. 114, Dec. 15, 1930, pages 609–622.

The reduction of Kiruna magnetite in H_2 and H_2–CO mixtures has been investigated. At 950° C., 0.2 mm. grains were completely reduced by H_2 in 2 minutes; 2.0 mm. grains in 7 minutes and 4.0 mm. grains in 17 minutes. The rate falls off with temperature but there is a marked discontinuity at 910° C. at which temperature the time required is 2.5 times that at 890° C. Addition of CO to the H_2 slows up the rate quite markedly, the rate in 100% H_2 being 7 times as great as in 100% CO. Pure CO also gives the same discontinuity as H_2 at 910°. Mixtures show the same but less markedly. The temperature at which the reduction becomes exceedingly slow, 900° C. corresponds to the transition point of α-Fe to γ-Fe. HCD(31)

The Treatment of Hollinger Precipitate to Produce Fine Gold. MATTHEW SCOTT (Supt., Hollinger Refinery). *Canadian Mining & Metallurgical Bulletin* No. 228, April, 1931, pages 466–476.

Calcium cyanide is the solvent used. Au and Ag are precipitated by Zn dust and the Crowe vacuum process. To each ton of solution, 0.045 lb. of Zn and 0.01 lb. of Pb acetate are added. Almost 10% of the total Zn remains with the precipitate. These solutions are filtered. The precipitate analyses 39% moisture and on a dry basis, 35% Au, 7.2% Ag, 1.4% Cu, 9.3% Pb, 14.6% Zn, 0.3% Fe, 0.5% alumina, 11.7% lime, 0.7% silica and 4.4% S. Zn, lime, Pb (present as a sulphide), Fe and alumina are removed by hydrochloric acid treatment. The Au, Ag and Cu are separated by an adaptation of the sulphuric acid parting process. AHE(31)

The Progress of Metallurgy at Broken Hill, N. S. W. M. R. MCKEOWN. *Chemical Engineering & Mining Review*, Vol. 23, Dec. 5, 1930, pages 93–100.

Three great stages have marked the metallurgy of Broken Hill and recent developments point to the commencement of a fourth stage, which may have a very considerable influence on contemporary practice. The stages are: (1) gravity concentration for the production of an argentiferous galena concentrate, (2) gravity concentration for galena followed by flotation for the recovery of granular zinc blende, (3) gravity concentration for galena followed by selective flotation for recovery of galena and blende from granular de-leaded tailings and from slime, and (4) all-flotation for galena and zinc blende recovery. Several flow sheets and tables are shown. Recoveries of metals have advanced and it appears as though in the cases of Zn and Pb at Broken Hill the economic limits have been reached. The extended use of alkaline circuits may be expected to effect further economies and further developments in coarse flotation are probable. WHB(31)

Extraction of Metallic Bismuth and Lead-Tin Alloy from the Flue-Dust Collected in Cottrell Chambers at Ashio Mine. JURO SHIMONO. *Suiyokai-Shi. Transactions of the Mining & Metallurgical Alumni Association, Kyoto*, Vol. 6, No. 5, 1930, pages 405–462.

Outlines of the scheme have been quoted in the *Engineering & Mining Journal*, Vol. 128, 1929, page 89. Further details are given as to equipment, operations, preliminary trials in the laboratory and critical studies on the present operations, showing numerous tables. By a reducing fusion with soda ash, lime, charcoal and scrap Fe of the sinter from the As plant containing about 4% of Bi, 76% are collected in a fusible alloy. Admixture of galena is beneficial for materials of lower grades. The alloy, after having been purified by liquation, is cast into anodes and electrolyzed in a fluorsilicate bath to obtain simultaneous deposits of Pb and Sn at the cathode leaving Bi as a sponge adhering to the anode. Standard figures are as follows: total acid 16, Pb 2.6, and Sn 4 g./100 cc.; with small additions of colloid. Current density 2.5–3 amp./ft.^{2}, voltage 0.1–0.35 and temperature 10–28° C. Bi content of the anode should be less than 28%, or the porosity of the sponge is reduced, thereby increasing the polarization and the amount of Sn remaining. As the presence of As and Cu prevents Sn from being dissolved, complete removal is indispensable in the preceding operations. Equilibrium is stated to be attained between Pb and Sn ions when their concentrations are 3 and 4.5 g./100 cc., as in such a case electrolysis went on smoothly for several months without adjusting the composition of electrolyte. When the total acid falls below 16, Pb ion becomes rapidly impoverished and tin increases in the sponge. Higher current density also causes Pb and Sn ions to diminish. Analyses of different parts of the anode and the sponge are given together with some photomicrographs showing the structures of the electrodes and deposits. Bi sponge of the grade 95% is thus obtained, liquated, cast into anode and subjected to electrolysis, of which the standard figures are given as fluorsilicic acid 40 g./100 cc., Bi 4.5–5.0. Current density 3.5 amp./ft.^{2} Voltage 0.15–0.25. Temperature the same as the above. Small additions of colloid are also needed. Analysis of the Bi produced gave Bi—99.90%, Cu—0.05% and Fe—0.048%. As, Sb, Pb and Sn were not found. Pb Sn alloy consists of 89–90% Pb and 6–10% Sn and is sold as a material of antifriction metals. With rise in the Cottrell efficiency, Bi production increased remarkably of late to as much as 10,000 lbs./month and more than fulfills the demand of Japan. Details are given also as to the preparation and purification of the electrolytes. YO(31)

Improvements in the Metallurgy of Quicksilver. L. H. DUSCHAK. *Transactions American Institute of Mining and Metallurgical Engineers*, 1930, pages 283–298.

Direct furnace treatment is well adapted for extraction of Hg. The Scott furnace serves well. Rotary furnaces produce considerable dust. Low grade ores or tailings can be economically treated by wet screening and flotation. Cinnabar, reduced Hg, and synthetic sulphides are easy to concentrate by flotation. Leaching of ores does not appear to be promising. 3 references. JLG(31)

Reduction of Magnetite and Limonite with Methane (Die Reduktion von Magnetit und Limonit mit Methan). O. MEYER & W. EILENDER. *Archiv für Eisenhüttenwessen*, Vol. 4, Feb. 1931, pages 357–360.

Two iron ores were reduced with methane at various temperatures, times and gas velocities. The most favorable gas velocity in reducing was determined first. It is shown that the velocity of reduction increases with the gas velocity to a maximum, and decreases again. The ores were reduced at 800, 850, 900, 950, 1000 and 1050° C. and the time of reduction was increased in intervals of 15 min. The gas velocity amounted to 3 l./hr. The time of reduction has been plotted in diagrams against the degree of reduction for the various temperatures used. The course of the curves for both magnetite and limonite indicates that methane does not directly reduce the ore. Its decomposition products, carbon and hydrogen, are the reducing media. The decomposition of methane is catalyzed by metallic iron, unless a sufficient amount of metallic iron has been formed. The application of methane for the production of sponge iron is considered. This seems to be successful in the case of a partial combustion of the methane used. GN(31)

Benefication of Iron Ores. *Transactions, American Institute Mining & Metallurgical Engineers, Iron and Steel Division*, 1930, pages 407–431.

A "round table" discussion at Chicago on Sept. 22, 1930. Discussion mostly on concentration, but includes consideration of furnace operation and low temperature reduction. JLG(31)

The Present Status of Our Quicksilver Industry. CHARLES G. MAIER (U. S. Bureau of Mines). *Transactions, American Institute Mining & Metallurgical Engineers*, 1930, pages 299–316.

Includes discussion. A symposium introduced by a general discussion of mercury extraction by Maier. The Scott, rotary and hearth furnaces are compared. Monel condensers are suitable only if chlorides are absent from the furnace charge. JLG(31)

Recent Development in Blast-Furnace Design and Construction. ARTHUR G. MCKEE & WILLIAM HAVEN. *Transactions American Society Mechanical Engineers*, Vol. 52, Jan.–Apr. 1930, pages 13–19; Discussion pages 19–24.

This paper deals with 2 recent and highly important developments in blast-furnace construction and practice: the trend toward furnaces having daily capacities of 1000 tons or more, and the profitable utilization of blast-furnace gas in the firing of coke ovens, open-hearths, and in the various types of heating furnaces employed in steel mills. These developments have involved certain structural changes in the stacks, which have in time necessitated changes in such auxiliaries as stock-house and blowing equipment, gas cleaners, hot-blast stoves, and boilers. These are all considered in detail by the authors. (31)

Iron Ore from Pyrite. *Iron & Steel of Canada*, Vol. 14, Jan. 1931, pages 10–17.

Description of a new method of burning pyrite, which involves the use of the pyrite obtained as a by-product of the flotation process. This pyrite, being in a very finely-divided form, requires burning in a manner similar to pulverized coal. The iron oxides remaining after combustion may be looked upon as suitable for reduction, provided some sintering has taken place. OWE(31)

Amalgamation Practice at Porcupine United Gold Mines, Ltd., Timmins, Ontario. RONALD A. VARY. *Bureau of Mines Information Circular* 6433, Mar. 1931, 5 pages.

The ore consists of quartz with fine stringers of mineralized basaltic schist, or of banded quartz schist, or of stringers of quartz in schist, accompanied by pyrite and often containing visible gold. It is amalgamated in a 25-ton, pilot mill. Costs per ton of ore treated are crushing $0.384, grinding 0.771 classifying, screening, conveying and refining 0.626, miscellaneous 0.070 and total $1.851. AHE(31)

The New Smelter and Concentrator of the International Nickel Company at Copper Cliff, Ontario. L. M. SHERIDAN. *Engineering Journal of Canada*, Vol. 13, Nov. 1930, pages 682–687.

After coarse-crushing by hand at the mines, the ore is shipped to Copper Cliff where it is crushed to 200-mesh and sent through a wet concentration to remove the rock. In the concentration process the sulphides are floated, and the lighter rock material sinks to the bottom. By selective flotation a rough separation is made of the Cu and Ni. Smelting comprises roasting in multiple hearth roasters in reverberatory furnaces and blowing in basic-lined Bessemer converters. The product is an 80% Cu-Ni matte. The layout of the smelter and concentrator is shown in a diagram. WHB(31)

Cyanidation of a Copper-Gold Ore. E. H. SMITH. *Canadian Chemistry & Metallurgy*, Vol. 15, Feb. 1931, pages 45–46.

The function of lime in cyanidation of gold ores is attracting much attention. Lime and alkalinity have no solvent action on the precious metals but enter into numerous reactions occurring in the process. A pyritic ore ground in lime solution yields calcium sulphide and calcium thiosulphate and gangue constituents consume a certain amount of lime. Each mineral in an ore removes lime from the mill solution in an amount dependent on the lime present and this amount is specific for each mineral. Lime decomposes the zinc cyanide or double cyanide formed in the precipitation processes. WHB(31)

Vanadium Recovery at Rhodesian Broken Hill. *Engineering & Mining Journal*, Vol. 131, Mar. 23, 1931, page 259.

R. H. Stevens and his staff have developed a process providing for the complete removal of Va from the electrolyte and permits its recovery. Va dissolves during the process of extracting Zn from the ore and must be removed. The Va is precipitated as Zn or Fe vanadate and a mixture of the two. The precipitate is caught in a filter press, washed to remove soluble Zn and discharged to a storage bin. Filtrate and wash water are returned to the Zn circuit. The precipitate is converted to a slurry pumped to storage tanks, agitated, and withdrawn as needed in the first step of the recovery process, in which Va is dissolved in a 7.5% caustic soda solution (prepared by treating sodium carbonate with burnt lime). The slurry and caustic solutions in definite proportions are agitated 1–2 hours at 100° C. in a steam-heated iron vat. Va dissolves as sodium vanadate Fe and most of the Zn remain insoluble. The pulp is filtered in a press, washed, broken up in a pug mill, and discharged to an agitator where the solids are suspended in Zn solution and pumped back to the Zn circuit. In the precipitation tanks Va hydrate is precipitated by the addition of sulphuric acid till an excess of 5 g. per liter of free acid is present. Excess acid lowers efficiency but gives a purer product. Va hydrate is filtered in a filter press and washed counter currently in the strongest wash water, being returned to the precipitation circuit. The cake is fed to a gas fired furnace where free and combined moisture are eliminated with the dehydrated oxide fused. Impurities consist of alkalies and small amounts of silica and Fe. The Va oxide (V_2O_5) is 90–95% pure. WHB(31)

WANTED

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MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

701 **Cold Rolled Strip Steel.**—Anyone who does not realize what an important part this product plays in our life should send for Bulletin No. 3 of the American Steel & Wire Company, 208 La Salle St., Chicago, Ill. Several pages are given over to illustrations of everyday applications of cold rolled strip steel and these will suggest many more. A table showing the approximate weight of 1000 feet of cold rolled flat steel wire of different widths is appended.

702 **AGA 1931-2.**—The American Gas Association, 420 Lexington Ave., New York, N. Y., presents its industrial advertising campaign in a most attractive portfolio. The series has been divided into advertisements for each of the most important industrial users of gas heat and anyone wishing to use them as enclosures imprinted with his own name and address may readily secure reprints or electrotypes.

703 **Thermometals.**—The Wilco Thermometals are duplex or bimetals. They consist of two metals with different rates of thermal expansion permanently bonded throughout their contact surfaces. Due to the difference in expansion of the members a change in temperature causes the bimetal to bend or deflect. It is this deflection which is utilized in the application of these metals to controls and indicating devices. A bulletin describing these metals is issued by the H. A. Wilson Co., 97 Chestnut St., Newark, N. J.

704 **Nickel-Clad Steel Plate.**—This plate provides the corrosion-resistance of pure nickel for heavy plate construction at economical cost. It withstands vacuum, severe vibration, mechanical shock, high temperatures and changes in pressure. The Lukens Steel Company, Coatesville, Pa., has sent out a number of descriptive pieces of literature about this product, among them being a reprint of an article, "Nickel-Clad Steel Plate Work," from *Mining & Metallurgy*.

705 **Grinding.**—The April issue of *Grits & Grinds*, published by the Norton Company, Worcester, Mass., features an article entitled "Grinding Pump Shafts," by H. A. Charles. It also contains several other articles on problems and developments in the grinding field.

706 **Cobaltcrom PRK 33.**—The latest booklet of the Darwin & Milner, Inc., 1260 West 4th St., Cleveland, Ohio, is devoted to a description of the physical properties of this alloy steel, which can be used for dies of all kinds, shear-blades, shearing press tools, etc.

707 **The Laboratory.**—The Vol. 4, No. 3, issue of this periodical published by the Fisher Scientific Company, Pittsburgh, Pa., describes several new instruments for the laboratory. One is a new vacuum still which permits liquids to be distilled at $^1/_2$-10 mm. Hg pressure with a new accuracy. Another is a new hand refractometer for measuring sugar content.

708 **Potentiometer Pyrometer.**—The Brown Instrument Co., Philadelphia, Pa., has published a new Catalog No. 1101, a 48-page book, well illustrated, with descriptions of fifty features of their new line of potentiometer pyrometers. The instrument has a broad application to industrial needs involving the measurement and control of temperatures, especially in the higher ranges.

709 **Welding.**—A 16-page publication entitled "Westinghouse Arc Welding Data Bulletin No. 15," has recently been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This booklet contains illustrations of some unusual arc welding achievements, explains with the aid of diagrams various methods of testing, and discusses methods for obtaining good welds. In this connection they have also published a leaflet, L-20518, describing the construction, operation and application of their Flex-Arc 600-Ampere welder.

710 **Material Handling.**—The Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill., has sent out the second Data Sheet in their series on Material Handling & Power Transmission. This one is entitled "Belt Conveyor Horse Power and Stress." These data sheets cover important phases of the subjects about which little has been published.

711 **Recording Gages.**—Bulletin 168 of the Foxboro Company, Foxboro, Mass., describes their modern gages which have an alloy-steel helical spring with welded steel connections. This material for gage springs has been used successfully for three years under all kinds of conditions. It combines safety with accuracy. This bulletin is a well-illustrated booklet of 23 pages.

712 **Sand Control.**—The June issue of *Better Methods* published by the Beardsley & Piper Co., Chicago, Ill., features an article entitled "Control of Sand Is As Important as Control of Metal in the Foundry." About 20 examples of defects in castings caused by improper molding sand and core practice are shown and remedies are offered.

713 **Heat-Treating Furnaces.**—Three leaflets have been prepared by the W. S. Rockwell Co., 50 Church St., New York, N. Y., which discuss different types of their heat-treating furnaces. No. 297 is devoted to their rotary type, electric and fuel, for ferrous and non-ferrous metals. No. 285 discusses the car and car-and-roll type, either electric or fuel, which is advantageously used for heating large and irregularly-shaped forgings or castings. No. 302 illustrates the continuous strand furnace which is electrically heated with automatic control. This furnace can also be arranged to clean the material.

714 **Hydrogen Ion Concentration Measurements.**—Catalog 75, issued by the Leeds & Northrup Company, Philadelphia, Pa., lists apparatus for determining hydrogen ion concentrations of solutions by the null potentiometer method. The descriptions of the various potentiometers indicate the conditions for which each one is most suitable, and the accuracy of which each one is capable in those conditions. Equipments for automatic measurement and control of acidity and alkalinity are also included. Their catalog No. 84 describes potentiometers for automatic temperature control.

715 **Nickel Alloy Steels in Airplane Engines.**—A 12-page booklet sent out by the International Nickel Company, 67 Wall St., New York, N. Y., gives a discussion of the principal features and service records of the complete Curtiss and Wright lines of airplane engines, with special reference to materials used in their construction. Numerous illustrations are included showing views of the different engine models, of important parts, and of planes in which these engines are installed.

716 **Rare Metals.**—The Fansteel Products Co., Inc., North Chicago, Ill., has prepared a new edition of their 72-page book entitled "Rare Metals." This is to give one an idea of the possibilities inherent in little-known metals and alloys that promise to alter the course of many industries. Tantalum, tungsten and molybdenum are the metals under discussion.

717 **Arc-Welding.**—Leaflet GEA-823C, of the General Electric Company, Schenectady, N. Y., describes their atomic-hydrogen arc-welding equipment for hand welding on 50- and 60-cycle circuits. This process of welding with hydrogen by continuous independent arc produces homogeneous, ductile welds on ferrous and non-ferrous metals and alloys.

718 **Copper and Brass.**—The June issue of the Bulletin of the Copper & Brass Research Association, 25 Broadway, New York, N. Y., illustrates a number of unique uses for these metals, some practical and some decorative.

719 **The Modern Soaking Pit.**—The Surface Combustion Corporation, Toledo, Ohio, has gotten out a particularly attractive and unusual booklet on soaking pits designed and installed by them. Layouts contrasting the old and modern types are shown. The latter is a one-way fired pit which saves building cost and allows a much more convenient arrangement.

720 **Udyblack.**—The Udylite Process Co., 30 East 42nd St., New York, N. Y., has developed a new black cadmium plating process. Particularly attractive results have been obtained on cast surfaces and on sand blasted forgings. An interesting account of this process and its applications will be found in the June 1931 issue of the Udylite News. This company has also prepared a folder on their cadmium plating process which is an exposition of the theory and practice of the science and art of electrolytic application of cadmium.

721 **Steel Castings.**—The Sivyer Steel Castings Co., Milwaukee, Wis. has compiled two useful little books, one entitled "Dependability in Steel Castings" and the other, "Steel Casting Patterns." The first of these discusses briefly the various steps in the process of making a steel casting, and describes the methods used to maintain steel casting dependability. The second tells about the construction of patterns, and standard foundry practice in reference to them.

722 **Magnesium.**—The Dow Chemical Co., Midland, Mich., has prepared a reprint of an article entitled "Magnesium, Industry's Lightest Structural Metal" by John A. Gann. In it are given a history of magnesium, foundry practice in the production of magnesium and magnesium-alloy castings, their heat-treatment and applications.

Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

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CURRENT METALLURGICAL LITERATURE ABSTRACTS OF METALS & ALLOYS

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These abstracts are not critical, but merely review developments. The classification number at the end of each abstract will be of assistance in mounting them on filing cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class.
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Book Reviews are included below and marked by -B-

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PATENT SERVICE

Until we resume regular publication in September, the service rendered by the Patent Department of METALS & ALLOYS will be carried on by Mr. W. M. Corse, 81. Eighteenth Street, Washington, D. C., who can supply copies of United States and foreign patents and translations at reasonable costs.

PROPERTIES OF FERROUS ALLOYS (3)

Chrome-Manganese Steels. FREDRICK M. BECKET. *Yearbook American Iron & Steel Institute*, 1930, pages 173–194.
Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 900. (3)

Properties and Application of Nickel and Nickel Chromium Steels. (Proprietes et applications des aciers au nickel et au nickel chrome.) J. GALIBOURG. *Revue de Metallurgie*, Vol. 28, Jan. 1931, pages 30–39; Feb. 1931, pages 85–100, 35 references.
A review of the properties of plain carbon, nickel, nickel chromium and stainless Ni-Cr alloys. JDG(3)

Heat- and Acid-Resisting Cast Irons with High Chromium and Carbon Contents. EMANUEL VALENTA. *Carnegie Scholarship Memoirs, Iron & Steel Institute*, Vol. 19, 1930, pages 79–165.
Paper received June 11, 1929 contains 40 references. A résumé of previous studies is followed by description of melting technique in preparation of alloys of this study. Analyses of 73 alloys of Fe-Cr-C with and without additions of Si and Al are given and their hardness for various thicknesses as cast, hardness as cast, as annealed at 1000° C. for 4 hours cooled slowly, and as air quenched from 1000° C. are tabulated and shown graphically. A discussion of micro- and macro-structures of these alloys is illustrated by 52 photographs. A study of the phase changes by quenching and dilatometric methods was made. Volume changes in these alloys at high temperatures were determined and results shown in graphical form. WLC(3)

A Heat- and Corrosion-Resisting Cast Iron. *Nickel Bulletin*, Vol. 3, Nov. 1930, pages 354–356.
New alloy contains about 75% cast iron, 4% Cr and remainder monel metal. Named "Nimol." Properties and suggested uses are given. MFB(3)

Properties of Spring Wire. (Beurteilung von naturharten Federdrähten.) K. THOMSEN. *Krupp'sche Monatshefte*, Vol. 11, Nov. 1930, pages 291–292.
The article considers in a general manner the tests to be made for passing judgment on the qualifications of steel spring wire. Brief description of the experiments of the Kaiser Wilhelm Institut für Eisenforschung on the determination of the elastic limit and the yield point by means of the torsion test. In testing basic open hearth steel wire of various compositions, heat treatment and drawing practice, it was found that the ratio between elastic limit, yield point and tensile strength is independent of the above factors. Similar experiments on acid open hearth steel are in progress. After blue annealing, the above ratio is changed to higher values, since blue annealing increases the elastic limit and the yield point to a larger extent than it increases the tensile strength. Zinc coated wires have a decreased ratio between yield point and tensile strength; they, therefore, are less elastic. Reference to the elastic properties of KA2 wire is made. Quality and suitability of spring wire can be judged satisfactorily by the tensile strength. GN(3)

Corrosion and Heat Resistant Nickel-Copper-Chromium Cast Iron. J. S. VANICK & P. D. MERICA. *Iron & Steel of Canada*, Vol. 13, Nov. 1930, pages 241–260.
Description of heat-resistant cast iron having the following analysis:

	Min.	Max.
Total carbon	2.75%	3.10%
Silicon	1.25	2.00
Sulphur	0.04	0.120
Phosphorus	0.04	0.30
Manganese	1.00	1.50
Nickel	12.00	15.00
Copper	5.00	7.00
Chromium	1.50	4.00

This has been investigated thoroughly in the laboratories of the International Nickel Co. and in the field during the past 3 or 4 years. The article deals with the applications of this material, with its development, with its mechanical properties, and with others of its physical characteristics. OWE(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion with Reference to Boilers. T. MILLICAN. *Advance Copy, North-East Coast Institution of Engineers & Shipbuilders*, Mar. 20, 1931, 14 pages.
The paper deals with various theories which have been advanced in explanation of the causes of corrosion, some of these theories being supplemented or altered in light of recent research. Effects are shown to be of various forms but that form which is most destructive to boiler plates is, unfortunately, pitting, which is that most generally met with. It is shown that where incrustation is allowed to form on the boiler heating surfaces there is a definite tendency to support corrosion due to differential aeration. Mention is made of a case considered unusual, but which might prove not be so unusual if investigation were more universally thorough, where decarburization of the surface of the metal was found to be due to overheating. Cases of corrosion in general are considered in respect to those types of boilers most commonly met with in practice and although methods of prevention are mentioned, having due regard to the danger of producing conditions which may give rise to caustic embrittlement, it is considered that probably each case of corrosion is a law unto itself and should receive thorough individual investigation. (4)

The Potential of Passive Iron. (Sur le potential du fer passif.) A. TRAVERS & J. AUBERT. *Comptes Rendus de L'Academie des Sciences*, Vol. 192, Jan. 19, 1931, pages 161–163.
The authors describe their experiments on the potential of passivated iron in various media, from the results of which they conclude that the expression "passive iron" is in no sense absolute in view of the fact that there are degrees of passivity, that it appears difficult to assume Evans's hypothesis of a film of oxide in all cases of passivation in view of the fact that the potential of iron immersed in various oxidizing agents varies according to the agent, and that values for the potential of metals susceptible to passivation (e. g., iron) depend essentially on the conditions in which the metals are placed. OWE(4)

Resistance of Metals to the System Urea–Water–Ammonium Carbamate. J. G. THOMPSON, H. J. KRASE & K. G. CLARK (Fertilizer and Fixed Nitrogen Investigations, Bureau of Chemistry and Soils, Washington, D. C.). *Industrial & Engineering Chemistry*, Vol. 22, July 1930, pages 735–736.
The results of tests on 36 metals and alloys are tabulated. MEH(4)

Corrosion Resistance of Light Alloys. H. SUTTON (Royal Aircraft Establishment, England). *First Communications of the New International Association for the Testing of Materials.* Group A, Zurich, 1930, pages 304–308, 19 references.
A list of English investigations on the subject with very brief comment on the results. Anodic treatment is advocated for aluminum alloys. No effective protection for magnesium alloys is yet known. Corrosion-fatigue studies on Al and Mg alloys are under way at the Royal Aircraft Establishment and the National Physical Laboratory. HWG(4)

The Rate of Solution of Magnesium in Acids. MARTIN KILPATRICK, JR. & J. HENRY RUSHTON. *Journal of Physical Chemistry*, Vol. 34, Oct. 1930, pages 2180–2186.
The preliminary report of an investigation of the rate of solution of metals in acids in aqueous and non-aqueous solution, from the standpoint of Brönsted's theory of acids and bases, which is likely to be of importance in the study of corrosion. The particular experiments described were designed to answer the question whether magnesium in formate-formic acid buffer solutions reacts with the acid H_3O^+ (hydrogen-ion), the existence of which is postulated by Brönsted, with the acid HCOOH, or with both. It is shown that the reaction with molecular formic acid predominates. Experiments with other solutions are dealt with. OWE(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Study of Special Steels—Constitutional Diagram of the 18% Cr Alloys with Variable Composition of Nickel and Carbon. V. N. KRIVOBOK. *Mining & Metallurgical Investigations U. S. Bureau of Mines & Carnegie Institute of Technology, Mining & Metallurgical Advisory Boards*, 4th Open Meeting, Oct. 17, 1930, 4 pages.

An outline of problems begun or to be carried out on 18% Cr-Fe alloys containing variable percentages of Ni and C is given. (5a)

Relations between Structure and Properties in Metallic Alloys. (Die Zusammenhänge zwischen Aufbau und Eigenschaften der Metall-Legierungen.) A. GUERTLER (Tech. Hochschule, Berlin-Charlottenburg). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 320–327.

Philosophical discussion of individual crystals of pure metals, of compounds, of solid solutions and aggregates. The article does not lend itself to condensation. HWG(5a)

Solidus Determination by Means of Heating Curves. J. H. ANDREW & H. NCNEIL. *Metallurgist*, Oct. 1929, pages 154–155.

Review of a paper in the *Journal of the Royal Technical College*. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 793. (5a)

Constitutional Diagram of Iron-Manganese Alloys. V. N. KRIVOBOK. *Mining & Metallurgical Investigations, U. S. Bureau of Mines & Carnegie Institute of Technology, Mining & Metallurgical Advisory Boards*, 4th Open Meeting, Oct. 17, 1930, 3 pages.

Tentative constitutional diagram was constructed from data supplied by thermal analysis, metallographic studies and X-ray patterns. It is believed there are at least 6 different phases: α-Fe, γ-Fe, ϵ-Fe, α-Mn, β-Mn and γ-Mn. (5a)

The Mode of Deformation of a Single Crystal of Silver. H. J. GOUGH & H. L. COX (National Physical Laboratory). *Institute of Metals, Advance Copy* No. 552, 1931, 18 pages.

A single crystal of Ag was subjected to alternating torsional stresses and the surface examined to determine the mechanism of deformation. Numerous slip bands were formed on the octahedral planes, but there was no definite evidence of twinning even when the stresses were applied until failure. The slip bands might have been narrow twins, but this appears to be improbable. No twins could be produced by compression. Because of the ease with which twinning occurs in an aggregate of small crystals, the mechanism of deformation in a single crystal must be essentially different from that in the aggregate. 7 references. JLG(5a)

Constitution of Light Magnesium-Copper Alloys. (Ricerche sopra la costituzione delle leghe rame-magnesio ricche in magnesio.) F. DE CARLI (Instituto Chimico R. Universita, Rome). *La Metallurgia Italiana*, Vol. 23, Jan. 1931, pages 18–21, 13 references.

Electrical resistance at 20°, 40°, 60°, 80°, 100°, 150°, 200° and 250° C. was determined on Mg alloys with 0.09, 0.28, 0.98, 2.5 and 5.4% Cu. From this it was concluded that the limit of solid solution of Cu in Mg is about 0.1% Cu at room temperature, varying slightly with temperature, perhaps approaching 0.2% Cu at 250° C. Specimens of compositions between 0.09 and 0.28% Cu were lacking; so the results are not very definite. HWG(5a)

Contribution to the Problem of Primary Crystallization. (Beiträge zur Frage der Primärkristallisation.) F. R. HENSEL (Doktor-Ingenieur dissertation). Technische Hochschule, Berlin, Jan. 1929, 38 pages. Published by Giesserei-Verlag, Düsseldorf. 72 references, 46 tables, 91 figures.

The orientation of the crystals in the transcrystalline zone in silicon steel was studied by several methods. A great number of castings of tin were made in ingot molds of various dimensions, the ingots sectioned, macro-etched and photographs shown, with tables describing the casting conditions. Other tests were made on silicon steel, lead, zinc and wax. Impurities in tin alter the macro-structure materially. Special experiments indicated that there is no undercooling in tin, and that the various zones of crystallization cannot be explained on the undercooling theory. No other very definite conclusions were reached, although a vast amount of work is recorded. Part of the work was done under Professor Desch at Sheffield, part under Professor Guertler in Berlin.—H. W. Gillett (5a)-B-

The Molecular Constitution of the α-Solid Solutions of Tin in Copper and of the Corresponding Liquid Solutions Examined Thermodynamically. F. H. JEFFERY. *Transactions Faraday Society*, Vol. 27, March 1931, pages 136–137.

Using the results of Raper and of Stockdale and of Heycock and Neville, it was shown by the thermodynamic method that in the Cu–Sn system, the α-solid solution consists of Cu_4Sn dissolved in monatomic Cu molecules. The liquid solution consists of Cu_4Sn dissolved in liquid Cu, the molecules of Cu being monatomic. PRK(5a)

The Molecular Constitution of the β-Solid Solutions of Tin in Copper Examined Thermodynamically. F. H. JEFFERY. *Transactions Faraday Society*, Vol. 27, March 1931, pages 137–139.

By slightly modifying the equilibrium diagram of the Cu–Sn system using the results of Raper and of Stockdale, evidence is afforded that the β-phase is a solid solution of monatomic Sn molecules in monatomic Cu molecules. PRK(5a)

The Microscope as a Practical Aid in the Cast Iron Foundry. ROY M. ALLEN. *American Foundrymen's Association, Preprint* No. 31–6, 1931, 84 pages.

The paper deals with the use of the microscope in studying cast iron from the point of view of providing information for the practical foundryman and young metallurgist. Effects of Si, S, P and Mn are discussed in detail. CHL(5a)

Silumin and Its Structure (Supplement). B. OTANI. *Kinzoku no Kenkyu*, Dec. 1930, pages 666–686.

The author's previous conclusion (Science Report of Tohoku Imperial University, Sendai, Vol. 15, 1926, page 679; *Journal Institute of Metals*, 36–2, 1926, page 243) on the mechanism of structure of silumin, i. e., Na solidifies by monotecto-eutectic reaction in the ternary system Al–Si–Na and consequently produces a modified fine structure of silumin, was confirmed by other ternary systems which undergo monotecto-eutectic reactions. Bi and Cd which undergo a monotectic reaction in the binary systems Bi–Al, Bi–Si, Cd–Al and Cd–Si was employed instead of Na. The addition of 0.5% of Bi shifts the eutectic point of Al–Si system by 2% to the Si side and any appreciable lowering or under-cooling of the eutectic temperature did not occur. The structure of the alloys thus obtained is finer than that of unmodified alloys, but it is a little coarser than that in the case of Na. By using Cd a similar result was obtained. Then Ni and Mg, which form a ternary eutectic with Al and Si, respectively, were examined. The eutectic points were 10° to 30° C. lower than that of the Al–Si system and did not show any under-cooling. But the structures were fine. Thus, the author showed the uncorrectness of under-cooling theory of silumin. Moreover Cr, Fe and Ca were also tested. The mechanical properties of all these alloys were examined and showed the correctness of the author's theory. KT(5a)

A Note on the Silver-Rich Aluminium-Silver Alloys above 600° C. T. P. HOAR & R. K. ROWNTREE (Cambridge). *Institute of Metals, Advance Copy* No. 555, 1931, 6 pages.

Alloys up to 15% Al were studied by thermal and microscopic methods. The results substantiate Petrenko's diagram except that the diagram is shifted to higher temperatures. The diagram is similar to the Cu-Al diagram. Contains 2 references. JLG(5a)

Constitution of Copper-Tin Alloys. SAMUEL L. HOYT. *Metal Progress*, Vol. 1, Sept. 1930, pages 104–106, 114.

(Recommended Practice Committee Releases, A. S. S. T.) A brief review of the work of various investigators in this field. Eleven references and a constitutional diagram of the tin-rich field are included. WHK(5a)

Recent Advances in Metallography. J. L. HAUGHTON (National Physical Laboratory, England). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 316–319.

Brief and extremely general comment on the services of metallography to metallurgy. Expresses the opinion that the question of the allotropy of zinc is not yet conclusively answered, but concedes that the purer the metal, the less marked are the indications of allotropy. HWG(5a)

Iron–Carbon System. (Le systeme fer-carbone.) EUGENE L. DUPUY. *Revue de Metallurgie*, Vol. 27, Dec. 1930, pages 686–692.

Historical review of the development of Fe-C equilibrium diagram, starting with Tchernoff, and its contemporary interpretation. JDG(5a)

Microscopic Investigation of Metals. V. N. KRIVOBOK. *Proceedings Engineers' Society of Western Pennsylvania*, Vol. 47, Feb. 1931, pages 45–62.

A non-technical review emphasizing the purposes of metallurgy, and the specific uses of metallography related thereto. With regard to inspection of metals and alloys, microscopic studies reveal the characteristics, the previous history of the sample and its suitability for a given purpose—but only when the sample is properly prepared by an experienced operator. This is illustrated by 7 microphotographs. The second phase of the metallographist's work is the inspection and investigation of material after a failure has occurred. Under the third category of work, the author discusses the development of new materials, and the illustrations show how to recognize definite changes in properties. The fourth function dealt with is true research or scientific metallography, under which 5 illustrations of martensite decomposition are discussed. MFB(5a)

The Structures of the High Chromium Stainless Steels and Irons. EDGAR C. BAIN. *Yearbook American Iron & Steel Institute*, 1930, pages 271–308.

Includes discussion. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 34. (5a)

On the Constitution of the Fe–C–Si System. Part II. Section through the Tridimensional Diagram at 8% Si. A. KRIZ & F. POBORIL. *Collection of Czechoslovak Chemical Communications*, Vol. 3, Jan./Feb. 1931, pages 61–72.

The properties of 7 alloys were investigated. These alloys were prepared by melting in an electric resistance furnace. The chemical composition of the alloys tested is given as follows:

Alloy No.	%C	%Mn	%Si	%P	%S	Ac_2 ° C.
34	0.14	0.43	7.97	0.041	0.011	645
35	0.21	0.31	7.87	0.045	0.011	660
36	0.34	0.40	7.63	0.062	0.015	645
37	0.50	0.48	8.12	0.038	0.016	650
38	0.86	0.38	7.94	0.062	0.023	650
39	1.88	0.46	7.45	0.052	0.024	665
40	2.7	0.55	7.84	0.097	0.009	665

Samples for thermal analysis and microscopic examination after heat treatment were taken from each alloy. Constitutional diagram of the ternary Fe–C–Si system containing 8% Si is given. The region of the homogeneous γ-phase does not exist in these alloys. The pearlitic transformation of the alloys with more than 0.48% C ends at the beginning of melting. The transformation Ac_2 in the alloys with 8% Si lies in the region $\alpha + C$ at 665° C. GTM(5a)

Structure & X-ray Analysis (5b)

Theory and Practice of X-Ray Analysis. WILLIAM H. BARNES (McGill University). *Canadian Chemistry & Metallurgy*, Vol. 15, Mar. 1931, pages 67–70.

A short review with brief mention of some of the fundamental conceptions on which the subject is based and an outline of a few of the fields of application. The production, nature of X-radiation and physical, chemical and biological effects thereof. Applications to spectroscopy and crystallography are noted. WHB(5b)

Technological Reflections on the X-Ray Testing of Materials. II. (Versuchstechnische Betrachtungen über die Material-Röntgenprüfung. II.) A. HERR. *Mitteilungen des Staatlichen Technischen Versuchsamtes in Wien*, Vol. 19, 1931, pages 60–78.

The author gives a survey of the methods of testing materials for defects with X-rays during the manufacturing process and on the finished product. In particular, he describes the possibilities, not only of finding that there are defects, but also of locating and determining exactly the extent of the defects from the X-ray photographs. Two methods are available to-day: one is the densographic method by von Schwarz, which determines the kind of defect from the blackness of the exposed film (negative); the other method is to locate the defect by measurement on 2 stereoscopic photographs. The apparatus and procedures are described in detail. A table giving the exposure times at different thicknesses of the material and the required voltage across the X-ray tube is added and the arrangement of the apparatus in tests on welded boilers, bridges, etc., is illustrated. The modern X-ray apparatus and safety arrangements against touching are also discussed and illustrations are given. 20 references supplement the very comprehensive paper. Ha(5b)

Gamma Rays in the Power Field. ROBERT F. MEHL & CHARLES S. BARRETT. *Power*, Vol. 73, Feb. 24, 1931, pages 340–432.

Gamma rays, emitted by radioactive substances, are as penetrating as X-rays from tubes operating at one or two million volts (ordinary industrial X-ray tubes require one to two hundred thousand volts). In use a small metal capsule containing the radioactive element is supported on a simple stand in front of the object to be tested and ordinary X-ray film in a light tight container is fastened on the opposite side of the object. Gamma ray radiographs have been taken through 6, 8 and 10 inches of steel while the limit of X-rays is $3^1/_2$ to $4^1/_2$ inches. Proper precautions must be taken to protect the operator. Radium is coming into use for inspection of large castings. A stern post weighing nine tons for a U. S. Navy cruiser, was examined, after installation by this method for internal defects, and numerous defects were found. On final trial the casting split in two requiring a complete replacement at a cost of $200,000. Such disasters can be prevented by γ-ray examination. A brief review of the characteristics of γ-rays is given. VVK(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Calibration of Testing Machines. (Eichung der Prüfmittel.) W. ERMLICH (Staatliches Materialprüfungsamt, Berlin). *First Communications of the New International Association for Testing Materials.* 1930, Group D, pages 173–181, 4 references.

Advocates use of standard test pieces or proving rings, used with a Martens' extensometer for calibration. Precise measurements show that the extension of a steel specimen within the proportional limit does not exactly follow a straight line Hooke's law curve. HWG(6)

Accuracy of Measurement and Variability of Test Results. F. C. LEA (University of Sheffield). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 198–204.

The more accurate the measurement, the less likely it is that the stress-strain diagram will be a straight line within the proportional limit. Hence, a definite strain should be set as the value to report for proportional limit instead of the first deviation from a straight line. This might be 0.001%. Similarly, yield point should be stated in terms of some arbitrary permanent strain. Below 600° C. the "limiting creep stress" in high temperature testing can probably be determined within 10%. Endurance tests carried to 10 million cycles should be within 5% of the truth. If the material requires more than 10 million cycles to show an endurance limit, it will ordinarily not be more than another 5% lower than the stress to give 10 million cycles unbroken. It is doubtful if indentation hardness figures can be stated within a probable error of 2%. The probable errors of weighing in good testing machines are less than 1%. HWG(6)

The Calibration of Testing Machines and the Variability and Attainable Accuracy of Testing Results. G. H. GULLIVER (D. Kirkaldy & Son, London.) *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 194–197.

Brief general discussion. HWG(6)

Volume Changes of Steel During Elastic and Non-elastic Deformation. (Ueber die Volumenänderung des Stahles bei elastischer und bildsamer Beanspruchung.) H. HANEMANN & R. YAMADA. *Archiv für Eisenhüttenwesen*, Vol. 4, Jan. 1931, pages 353–356; *Stahl und Eisen*, Vol. 51, Feb. 19, 1931, pages 225–226.

The mathematical principles of the testing equipment and a description of it are given. In increasing the load of the tensile testing machine, the changes of length and diameter of the test bars were determined and used to calculate the changes of volume. The tests were carried on on soft steel, annealed or pre-deformed 5%, 10% and 15%. The volume increases in all cases as a linear function of the true tension up to the yield point. As soon as the yield point is reached, the increase of volume is irregular and larger than in the field of elasticity. This additional increase of volume is supposed to be due to internal shearing stresses. GN(6)

The Resistance of Chromium-Plated Plug Gages to Wear. HARRY K. HERSCHMAN. *Bureau of Standards Journal of Research*, Vol. 6, Feb. 1931, pages 295–304.

An investigation of chromium-plated plug gages with particular reference to resistance to wear was made. Chromium was deposited on hardened 1.0% C steel under varying conditions so as to produce what are commonly referred to as "bright," "milky" and "frosty" deposits. The "bright" deposits were tested in both the lapped and unlapped conditions. The other 2 types were tested in the lapped condition only. The scratch hardness values of chromium-plate produced under these varying conditions were studied with a view toward seeking an explanation for the cause of differences in the rate of wear exhibited by the various types of deposits. Metallographic examination of the plate showed the presence of strain lines or cracks on the surfaces of the plated gages. (6)

Comparison of the Results of Different Tests, such as Tensile Strength, Hardness, Elongation, Folding, Bending and Torsion, Relation to Structure, etc. (Verleich der Messergebnisse verschiedener Versuchsarten wie Zugfestigkeit, Härte, Dehnung, Einschnürung, Falt-, Biege-, Verdrehungsziffern, Struktur, Textur, usw.) W. HEROLD (Vienna). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 9–18.

Compares various formulae for prediction of endurance limit and suggests a "tearing strength" figure as showing closest relationship. If R is tearing strength, U is ultimate tensile strength, A is uniform elongation, and B is contraction of area, $R = U(1 + A)[2 - (1 + A)(1 - B)]$. The endurance limit equals 1/4 R. This is said to hold for a variety of carbon and alloy steels. No non-ferrous materials are included in the study. Even for steel, this factor, perhaps averaging 0.25, may vary from 0.22 to 0.27, so that actual endurance tests cannot be replaced by the calculation from the static tension test. HWG(6)

The Hardness Test in Practice. M. MOSER. *Metallurgist*, Dec. 1929, pages 189–190.

A survey of modern methods of hardness testing. The limitations of the Brinell method are set forth and different Brinell testing machines are described. Herbert pendulum hardness, according to the author's opinion, is still divided on its utility and field of application. Translated abstract of an article previously abstracted from *Krupp'sche Monatshefte*, June 1929. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 341. (6)

New Method of Making Ball Hardness Tests of Metals and a Plotting Table for the Simplification of "Meyer (hardness) Analysis." HUGH O'NEILL. *Carnegie Scholarship Memoirs, Iron & Steel Institute*, Vol. 19, 1930, pages 19–38.

8 references. The theory of hardness testing is discussed and the desiderata for a hardness test outlined. The author describes his diamond ball hardness tester. The Meyer analysis involves the determination of two mathematical quantities related as: $L = ad^n$, where L is the load, d the recovered diameter of the indentation, a represents the so-called "unit diameter hardness" and n a "hardenability" or "strain-hardening capacity" factor. The author presents a plotting table for quickly determining the values of a and n graphically. WLC(6)

Photoelasticity and Its Application in Design. R. V. BAUD. *Machine Design*, Vol. 2, Nov. 1930, pages 29–32; Dec. 1930, pages 27–30; Vol. 3, Jan. 1931, pages 37–40, 52.

The first article discusses the choice of methods enabling the designer to judge the safe load of a structure when no service records exist: one is to combine all factors involved in a destruction test; the other to secure stress field information. This second again divides itself into the method of analytical computation of stresses, and the more practical way of making photoelastic tests. The principles are explained, the instruments described, definitions given, and 8 well-selected illustrations contribute to the exposition. The second article covers work done at the mechanics division of the Westinghouse Electric & Mfg. Co.'s research laboratories on gears, bolts, suspension insulators, glassware and locomotive side frames. The third article similarly treats rails; welds; fastening: (a) turbine blades; (b) salient poles; (c) airplane propellers; turbo-elements: (a) coil retaining wedges; (b) teeth and end-plates; commutators. MFB(6)

Deflection of Small Springs Measured Accurately with Novel Tester. F. A. HARSHBERGER. *Electrical Journal*, Vol. 28, Feb. 1931, page 127.

A machine consisting of a simple balance arrangement has a unique provision for testing both the tensile and compressive conditions without change of set up. The tester, which is illustrated is simple in construction and can be made from a few spare parts. The construction is outlined. WHB(6)

The Preparation of Manganese-Free Magnesium. ELSA R. ORENT & O. S. RASK. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2776–2779.

The method consists of an oxidation of the Mn to permanganate form by means of potassium periodate, followed by electrolysis in a specially designed cell in which magnesium hydroxide deposits in a cathode-containing compartment and the permanganate in an anode-containing compartment. An essential feature of the cell is an arrangement whereby hydrogen from the cathode is kept from the permanganate. MEH(7b)

Tests of the Resistance to Repeated Pressure of Forged, Riveted and Welded Boiler Shells. Paper No. FSP-53-6. H. F. MOORE. *Transactions American Society of Mechanical Engineers*, Jan.-Apr., 1931, pages 55–64.

Contributed by the Power Division and presented at the Semi-Annual Meeting, Detroit, June 1930, of American Society of Mechanical Engineers. Data regarding the performance of welded joints in resisting repeated stresses are very important in any consideration of the adoption of welded construction for power boilers, and it is the object of this paper to present such data. Comparative tests were made on (1) a standard A.S.M.E. riveted drum, (2) manganese-steel riveted drum, (3) forged seamless-steel shell, (4) 2 forge-and-hammer welded shells, and (5) 8 fusion-welded (metallic-arc) shells, each drum or shell being subjected to applications of pressure well above the allowable working pressure. The results indicate that under repeated stress properly made welded joints are stronger than the plates themselves when weakened by "stress raisers" such as small holes or surface defects. The tests also give useful data on the strength of drum heads when subjected to intermittent pressures. Paper is followed by interesting discussions sent in by 7 specialists. In "Author's Closure" it is brought out that the number of cycles of stress above the endurance limit which a metal will endure without failure is no reliable criterion of its fatigue strength under millions of cycles of working stress. However, when a boiler shell withstands 100 times the number of cycles of stress it will be called upon to stand in actual service, it would seem to be reasonably safe so far as mere fatigue strength is concerned. MFB(6)

The Calibration of Testing Machines. H. F. MOORE (University of Illinois). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 182–190, 7 figures.

Calibration can be done by direct loading, loading through a lever arm, or by using a test specimen strainometer or proving ring, itself previously calibrated by means of standard weights. Methods of the Bureau of Standards are described. HWG(6)

Relation between Materials Testing and Suitability for Use. Comparison of Results of Various Test Methods. (Zusammenhänge zwischen Materialprüfung und Gebrauchseignung. Vergleich der Ergebnisse verschiedener Prüfungsmethoden.) M. ROS & A. EICHINGER (Materialprüfungsanstalt, Switzerland). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 18–25, 4 references.

Wear tests of rails on the Amsler wear machine are greatly affected by presence of the particles worn off. Wear tests agree well with service results, but choice of rails cannot be made on laboratory tests alone. Broken and unbroken rails showed no appreciable differences in tensile or impact values, but a transverse bending test on the base of the rail showed a difference, deflection being almost 10 times as great in unbroken rails. Endurance properties cannot be predicted from static tests. HWG(6)

Brinell, Rockwell and Scleroscope Hardness of Non-Ferrous Metals. O. SCHWARTZ. *Metallurgia*, Vol. 3, Jan. 1931, pages 109–112.

Translated from *Zeitschrift für Metallkunde*, June 1930. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. JLG(6)

Elastic and Inelastic Behavior in Spring Materials. M. F. SAYRE. *Progress Report No. 7 of the A. S. M. E. Special Research Committee on Mechanical Springs* (Technological). Presented at December 1930, Annual Meeting.

Continuation of the fundamental studies begun in *Progress Report No. 5, Trans. A. S. M. E.*, Vol. 52, No. 15, May-August, 1930, paper APM-52-9. The new results were obtained by the use of dead-weight loading instead of a testing machine as in the previous work. Other features were the use of long gage lengths and accurate control of temperature. The aim was a very high order of precision. Report (partial) gives numerous graphs and one summarized table of moduli of elasticity. Among other results, it is shown that energy loss increases sharply with the stress, at a higher power than the square; that non-ferrous materials do not exhibit sharp rise in hysteresis on approaching yield point as in the case of heat-treated steels; that hysteresis loops are unsymmetrical and typically convex upward; and that in successive loops, starting from the same nominal initial load and rising to successively greater peak loads the ascending lines essentially coincide while the descending lines differ for the different loops. See also *Metals & Alloys*, Vol. 1, May 1930, page 524. MFB(6)

Dynamic Phenomena in Fatigue Testing Machines. (Dynamische Erscheinungen in Maschinen zur Prüfung der Schwingungsfestigkeit.) S. SÖRENSEN (Kiev, Russia). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 40–47.

Mathematical. Loading through a weak intermediate spring is advised to avoid excess stresses. HWG(6)

Testing of the Surface Conditions of Sheets. (Zur Prüfung der Oberflächenbeschaffenheit von Blechen.) E. GEROLD. *Stahl und Eisen*, Vol. 51, Jan. 22, 1931, pages 104–106. Report from the Research Department of the United Steel Works, Dortmund.

Various methods have been used to determine the luster of steel sheets. The Kempf-Flügge and the Askania Luster meters were used in these tests and compared with a method developed by the United Steel Works. The last-mentioned method uses a photo-electric cell by means of which the luster can be determined through the inclination of an electric measuring instrument. This new method is suitable for routine shop testing and is preferable to the other methods mentioned above for scientific work. GN(6)

Investigation of Cold-Drawn Bridge Wire. L. S. MOISEIFF. *Proceedings American Society for Testing Materials*, Vol. 30, 1930, Pt. 2, pages 313–349.

Description of tests made on wire for the Ambassador Bridge, over the Detroit River. The tests were carried out by W. A. Slater and B. Stoughton at Lehigh University. Nothing unusual was found. Room temperature creep tests were made at 74,000, 93,000 and 113,000 lbs./in.^{2} Creep at the lower loads was so small as to be of the order of magnitude of errors of observation. At the higher load, the creep up to 2 mo. was 0.00024 in./in.; but all but 0.00001 in./in. of this occurred in the first 2 weeks. The wire was acid open-hearth steel of about 0.80% C. Tensile strength was about 210,000 to 230,000 and proportional limit 90,000 to 120,000 lbs./in.^{2} Kinking and otherwise mishandling the wire had no noticeable effect on the strength. HWG(6)

Second Report on Comparative High-Temperature Tension Tests of Metals at Different Laboratories. H. C. CROSS, *et al.* *Proceedings American Society for Testing Materials*, Vol. 30, 1930, Pt. 1, pages 96–109.

Short-time temperature tensile tests on the same materials, a 0.17% C steel, a stainless steel and a chromium molybdenum steel, made in several different laboratories showed variations in degree of temperature uniformity, and difference in selection of coördinates for plotting results. The maximum deviation from the average was only ±5% in figures for tensile strength, but as much as ±25% for those of proportional limit. Various points in testing technique need to be under better control. The detailed results are given in 5 tables and figures. HWG(6)

Stethoscopic Examination of Welded Products. J. R. Dawson (Union Carbide & Carbon Research Laboratories). *Preprint, American Society for Testing Materials*, Mar. 1931, 5 pages.

Judging the soundness of a weld by the sound produced on tapping it with a hammer is feasible on materials up to 1 1/2" thick. Defects that reduce the strength of a weld by 5 or 10% can be detected, melted out and re-welded. Automatic sound-recording devices to minimize the personal factor are being studied, but aural judgment would ordinarily be relied upon. HWG(6)

Compressive Tests of Jointed H-Section Steel Columns. James H. Edwards, H. L. Whittemore & A. H. Stang. *Bureau of Standards Journal of Research*, Vol. 6, Feb. 1931, pages 305–338.

Jointed steel columns consisting of various combinations of 10 in., 12 in. and 14 in. rolled steel H-sections, were tested in compression. Some of the tests were made with the axes of the columns in line and the others with the outer faces of both upper and lower columns in the same plane. Each combination of H-sections and column arrangement was tested with 5 bearing plates ranging in thickness from 1 to 4 1/4 in. using "low loads" giving an average stress not exceeding 8,500 lbs./in.^{2} in the smaller (upper) column. Tests to failure and repeated load tests were made on a few specimens. Strain-gage readings were taken on 2-in. gage lines on the columns and on 8-in. gage lines on the plates. The deflection of the bearing plates was measured. (6)

Welding Tests. Necessity for Standardization. (Essais des Soudures. Nécessité de standardiser les Essais, Propositions.) H. Dustin (University of Brussels). *First Communication of the New International Association for Testing Materials*, 1930, Group D, pages 48–55.

Brief comment on various methods of testing welded test-pieces. HWG(6)

Wear of Materials under Dry Friction. (Ueber Verschleissbarkeit der Werkstoffe bei trockener Reibung.) M. Füchsel (Berlin Railway Testing Laboratory). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 95–112. Contains bibliography of 275 references on wear and wear testing appearing from 1864 to 1929.

Brief general statement of variables affecting wear, general comment on types of testing machines that have been tried, and an extensive bibliography. Wear testing is still a research method, not suitable for purchase specifications, but will help to show the more suitable types of materials. See also *Metals & Alloys*, Vol. 1, Apr. 1930, page 473. HWG(6)

The Calibration of Testing Machines for Heavy Loads. (Ueber die Eichung von Festigkeitsmaschinen für grosse Lasten.) P. Fillunger (Vienna). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 191–193.

Mathematics of extrapolation in calibration beyond the loads which can be applied as actual weights. HWG(6)

Critical Review of Testing Methods for Welded Seams. (Kritische Betrachtung der Prüfverfahren für Schweissnähte.) H. Kemper. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 5, 1930, pages 65–93.

The author distinguishes between 2 different methods of testing welded seams: the preventative methods, which serve to control the welding work proper and control of the worker, and whereby the test piece is destroyed; and the testing methods, by which the welds made in ordinary routine operation are tested on the finished piece for their quality without destruction of the piece. All of these methods have been subjected to a critical review and the methods of the first class: the tensile strength test, bending test, behavior at high temperatures, hardness test, twisting test, notch-impact and tearing test, fatigue test, metallographic examination are discussed, described and illustrated. To the second class belong judging of quality of welded seam by appearance, electrical test (Sperry test), magnetic tests, acoustic methods, X-ray examination. All methods and apparatus required for it are fully described. 34 references. Ha(6)

Stress Cycles in Gear Teeth. R. V. Baud & E. Hall. *Mechanical Engineering*, Vol. 53, Mar. 1931, pages 207–210.

Previous papers on photoelastic stress analysis at the Westinghouse Research Laboratory may be said to have made history. But the shape of the single-tooth stress curves had not been explained and it was said that "since these curves are of considerable importance, it is contemplated to repeat this experiment with improved test conditions, in which we shall have larger teeth without initial stresses and in which we contemplate using the compensation method and applying only torque of such magnitude that the stresses will be within the proportional limit of the material." These tests have been completed and the paper discusses the results obtained and gives simple rules by which it will be possible to approximate the stress cycles for similar teeth. The paper gives the computation of the actual maximum stress at the fillet of a pinion tooth for various positions of the load, assuming but one tooth in contact at any time. MFB(6)

Flow Characteristics of Some Lead Cable Sheath at Temperatures above Atmospheric. Paper No. FSP-52-32. C. L. Clark & C. Upthegrove. *Transactions American Society of Mechanical Engineers*, Vol. 52, Sept.-Dec. 1930, pages 249–254.

Paper gives results of an investigation with ingenious new apparatus on 3 types of lead cable sheath differing only in the antimony content, which was, respectively, 0.06, 0.6 and 1.2%. At room temperature all 3 compositions elongated at more or less fixed rates with loads as low as 245 lbs./in.^{2} Results would indicate that similar behavior would be obtained with still lower loads and that the behavior of lead at 70° F. should be similar to that of plain C steel at a temperature above its equicohesive range. Increasing Sb content does not result in a decrease in the rate of flow at the lower temperatures, but in a lowered resistance to creep. At 80° to 120° C. higher Sb content results in comparatively high rate of creep. MFB(6)

Static Foundations for Fatigue Fracture. (Statische Grundlagen zum Schwingungsbruch.) W. Kuntze. *Mitteilungen der deutschen Materialprüfungsanstalten, Sonderheft* 14, 1930, pages 17–22; *Zeitschrift Verein deutscher Ingenieure*, Vol. 72, Oct. 20, 1928, pages 1488–1492.

Discussion, in very general terms, of the relationship of factors such as hysteresis, beginning of slip, behavior of notched tensile bars, changes in elastic limit with cold working and other factors determinable by static tests, with fatigue failures. HWG(6)

Experiments to Determine the Friction Coefficients of Lining Materials of Dry-running Automobile Motor Clutches. (Versuche zur Ermittlung des Reibungskoeffizienten von Belagmaterial trockenlaufender Automobilmotorenkupplungen.) Dr. Florig. *Messtechnik*, Vol. 7, Jan. 1931, pages 11–13.

From the Institute of Automotive Vehicles at the Technische Hochschule Dresden. Describes fully a test arrangement for measuring the friction coefficients as function of the pressure between materials, of slip, and of temperature. Results in short are: the friction coefficient of motion reduces somewhat with increasing pressure, the coefficient of rest increases somewhat. With increasing slip the friction coefficient increases for constant temperature, with increasing temperature the coefficient decreases. The coefficient of rest is always lower than the coefficient of motion. The best material is asbestos which is compressed after weaving and ground even. It can stand temperatures up to 350° C. and pressures of 2 kg./cm.^{2}; it has a friction coefficient of 0.3. Asbestos with wire stands the same temperature and has 0.2–0.3 for friction coefficient; but the pressure should be not more than 1 kg./cm.^{2} Ha(6)

Notch Toughness and Static Indices. (Kerbzähigkeit und statische Kennziffern.) W. Kuntze. *Mitteilungen der deutschen Materialprüfungsanstalten, Sonderheft* 14, 1930, pages 27–35; *Archiv für Eisenhuttenwesen*, Vol. 2, Mar. 1929, pages 583–590.

Rather general discussion of the relation of rate of absorbing energy, technical cohesion strength (Trennfestigkeit) obtained by extrapolation from tensile tests on notched bars, elongation, reduction of area, changes during stretching and drawing, ability to stand deformation, etc., etc., with notch toughness. A material may be very ductile in static tension, with high elongation and reduction of area, and yet be notch-brittle. A high ratio of "technical cohesion strength" to tensile strength in an alloy that has not been deformed, means high notch toughness. HWG(6)

Notched-Bar Tests. E. Hoeg (Danish State Testing Institute). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 213–216.

Overheating a 0.15% C open-hearth steel at 1100° C. followed by air cooling caused its impact resistance to drop (key-hole notch, square Charpy bar), but on then air-cooling from 900°, the impact resistance was restored. The impact figures are, in kgm./cm.^{2}, original, 18.3; 1100° C. — 1 hr. air cool 10.3; 1100° C. — 2 hrs. air cool 7.6; 1100° C. — 3 hrs. air cool 3.3; 1100° C. — 3 hrs. air cool, 700° C. — 1/2 hr. air cool 4.5; 1100° C. — 3 hrs. air cool, 900° C. 1/2 hr. air cool, 16.2. Specimens from a boiler that had exploded were tested at various temperatures. Average longitudinal and transverse impact was in kgm./cm.^{2} — 20° C, 0.9; +1° C., 3.3; +15° C., 7.0; +250° C., 7.8; +500° C., 3.3; after annealing at 700° C., the figures were +15° C., 10.2; and after annealing at 850° C., +15° C., 8.7; +500° C., 3.1. That is, at 500° C., the rejuvenation brought about by the 850° C. treatment, is lost. HWG(6)

Wearing Tests on Iron and Steel. (Om nötningsprov a järn och stal.) Arvid Johansson. *Jernkontorets Annaler*, Vol. 114, Nov. 1930, pages 551–571.

Lectures delivered at Tekniska Högskolan during 1928. A critical discussion of various tests for wearing resistance including Robin's, Brinell's, Spindel's and Amsler's. The general conclusions are that wearing resistance increases with increased C content, with increased coarseness of structure and with increased speed of rotation. The general status of the results is, however, highly uncertain. Problems for further research are: The effect of crystal structure as determined by the chemical analysis, the heat treatment, the final working temperature and the slag inclusions. 7 references. HCD(6)

Tests on Electric Arc Welded Lap Joints. R. P. Davis & L. V. Carpenter. *Research Bulletin* No. 7, Eng. Expt. Station, W. Va. University, Series 16, No. 2, Nov. 1930, 16 pages.

Tests of a few lap welds, some longitudinal, some end welds with 1/4 or 1/2" weld fillet, and varying length of weld. Striking the specimens with a hammer after welding and listening to the "ring" did not give any correlation with the tensile test. Long welds were weaker per lineal inch than short ones, and the unit strength of a 1/2" weld fillet is less than that of a 1/4" fillet. HWG(6)

Tensile Strength of Threaded Rods. R. P. Davis & L. V. Carpenter. *Research Bulletin* No. 6, Eng. Expt. Station, W. Va. University, Series 16, No. 1, July 1930, 12 pages.

Structural steel rods from the stock room, composition and structure not stated, were tested unmachined, and turned to a smaller diameter. A 5% increase in unit tensile strength on the turned rods is ascribed to "cold working." The tensile strength of threaded rods based on area at root of threads is 15% greater than plain, unmachined rods, but if the stress was applied by turning down the nut, the strength was less than with the plain rods. HWG(6)

Relation between Deformation in Tensile and Bending Tests. (Zusammenhang zwischen den Deformationserscheinungen in der Zug-, und Biegeprobe.) J. Bartel (Budapest). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 31–36.

Fracture in a bend test starts from the middle rather than from the edge of the specimen, because the middle is undergoing the greatest change in area. The change depends on thickness of bar and radius of bend. HWG(6)

The Deformation of Metals Under Prolonged Loading. Part I. The Flow and Fracture of Aluminum. D. Hanson & M. A. Wheeler (The University, Birmingham). *Institute of Metals, Advance Copy* No. 554, 1931, 29 pages.

Al samples were subjected to static loads at room temperatures and at 250° C. The mode of deformation was determined by microscopic examination of the polished and unetched surface of the test specimens. Samples consisting of various sized crystals, including single crystals were used. The conclusions, as given in the synopsis are: "(1) The extension under a prolonged load that will ultimately break the metal may be conveniently considered as consisting of 3 periods: (a) a period of primary extension, during which the rate of flow diminishes; (b) a period during which the flow is very slow or even suspended; (c) a period during which the extension again continuously increases until fracture occurs. (2) During the first period the flow of the metal is the result of slip within the crystals, and flow diminishes owing to the hardening effect of slip. (3) The behavior during the second and third periods varies with different specimens. (4) Three types of failure have been recognized under creep conditions: (a) failure by intercrystalline cracking; cracks form while the elongation is low, and the metal fails with little reduction of area at the fracture; (b) failure by the resumption of slipping within the original crystals, leading to a fracture of the normal type; (c) failure through the recrystallization of the metal, removing strain-hardening and permitting further flow of the softened metal: the metal pulls out to a point fracture, with a high elongation. (5) Al can fail by "creep" at room temperature. (6) Al consisting of uniform aggregates of crystals fails at 250° C. by intercrystalline cracking. (7) Al aggregates at room temperature, and Al single crystal specimens at all temperatures, fail under creep conditions by shear along the slip planes. (8) In single crystals when flow recommences slip occurs only on some of the surfaces that had previously slipped during the primary flow. (9) The prolonged action of a suitable stress can cause disintegration of a metal either at the junctions of the grains or on the surfaces of previous slip, and failure (i. e. fracture) must be regarded as having commenced when this weakening occurs. (10) Under suitable conditions, e. g. in crystal aggregates with moderate rates of flow at 250° C., or with very slow rates of flow in single crystals, slip is distributed over a very large number of slip surfaces, and a polished surface of the metal may show little or no signs of slip bands. (11) No change in density is believed to occur when a crystal is distorted by moderate amounts: changes in density in the case of crystal aggregates are thought to occur at grain boundaries. (12) The view is expressed that rupture of the crystals commences along slip planes formed at an early stage in the deformation of the metal. (13) The results are consistent with the theory of slip and rupture previously advanced by Gough, Hanson and Wright." Contains 4 references. JLG(6)

Ideal and Practical Relations between Elasticity and Plasticity, Tenacity and Brittleness. (Begriffliche und prüfmethodische Beziehung zwischen Elastizität und Plastizität, Zähigkeit und Sprödigkeit.) P. Ludwik (Vienna). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 63–71, 18 references.

Discussion of type of failure in tension, shear and repeated stress. Three-dimensional stresses are considered. HWG(6)

Comparison of the Results of Different Tests, such as Tensile Strength, Hardness, Elongation, Contraction, Folding, Bending, Torsion, Fatigue, Notched-Bar, etc. (Vergleich der Messergebnisse verschiedener Versuchsarten wie Zugfestigkeit, Härte, Dehnung, Einschnürung, Falt-, Biege-, Verdrehungsziffern, Schwingungsfestigkeit, Kerbschlagprobe, usw.) W. KUNTZE (Berlin, Materialprufüngsamt). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 1–8, 5 references.

Advocates use of an extrapolated value "Trennfestigkeit," (Technical Cohesion Strength), obtained by tensile test on notched bars (60° notch) and plotting the results so as to extrapolate to zero cross-section (complete notching), or by the formula $T = U + F/f\ (N - U)$ where T is Trennfestigkeit, U is ultimate strength by tensile test on an un-notched bar, F is the area of the notched tensile bar breaking section before notching, f the area at the root of the notch, and N is the strength per unit area of the notched bar. The figure T represents the strength when local deformation is entirely inhibited. It is a true material constant. Ability to resist flow increases with T. A yield point value is not a true material constant, but depends on speed, form and temperature. The maximum uniform elongation before necking starts and the local contraction thereafter have 2 different meanings in relation to resistance to flow. The latter is related to notch-toughness, more directly than is the total work to fracture in tension. Endurance limit may be calculated by a formula involving the ultimate tensile strength, an exponent (which is slightly different for tension, compression and for repeated bending endurance tests), the stresses at the end and at the beginning of the uniform necking-down period. Tensile tests in which load, at beginning and end of uniform elongation, maximum load, load at fracture, and the uniform elongation and local contraction at each stage are noted, together with the notch tensile test and notched bar impact tests, should throw light on the danger and the cause of fracture. HWG(6)

Materials for and Wear of Plowshares. (Werkstoffe und abnutzung von Pflugscharen.) K. GALLWITZ (Doktor-Ingenieur dissertation, Tech. Hochschule, Berlin), June 1929. Published by G. Zichaus Dessau, 1930. 50 pages.

Several year's work was put upon a field study of the wear of plowshares, in which the relative wear of the share was compared with the wear upon a standard soft steel (130 Brinell) specimen fastened to the coulter of the plow. This comparison took care of differences in the nature of the soil plowed. If the soil were first harrowed and rolled, the wear results were more consistent. Laboratory tests were made by running 3 shares, mounted on a revolving frame, turned by a 30 kw. motor, in sand, held in a ring-shaped cement canal. The shares moved at 3 m./sec. The cross-section of the ring of sand had a breadth of about 80 cm., and a height of about 40 cm. Building sand of a range of grain sizes from 1 to 1/4 mm. (mostly 1/2 mm.) was used, and maintained at 10% moisture. Weight losses in individual tests on full-sized shares were 5 to 30 g. in the laboratory per 10 km. run, and 30 to 600 g. in the field tests per 3 km. run. Many precautions as to angle of setting of the shares, running only shares of the same size together in the laboratory test so that a big one will not throw some of the sand out of the way of the following one, etc. were worked out. In any set of tests, the comparative rates of wear in g./cm.^{2} in the laboratory and in the field tests (after correcting the latter for nature of the soil by means of the control specimen) agreed very well, indicating that the laboratory method gave true results.

All the shares had hardened edges, but were soft at the bolt-holes except one 1.2% C, 10.7% Mn steel, and a few unhardened carbon steels put in for comparison. The wear was in quite direct proportion to the unhardened area. Quite a range of steels were used, most of them 0.50 to 0.70% C, several with Mn from 0.80 to 1%. One that showed up well contained 0.45% C, 1.8% Mn. The austenitic 10.7% Mn, 1.2% C steel of 193 Brinell showed as good results.

Poor results were obtained with shares whose edges showed Brinell hardnesses over 600, these having been over-heated, and showing Widmanstätten structure. Such shares often have quenching cracks.

The edge of the share should be between 400 and 550 Brinell, and as much of the share should be of that hardness as possible, as long as the zone about the bolt-holes is tough. Only in especially strong ground is it necessary to sacrifice hardness of the edge and body of the share for toughness. The investigation did not lead to any conclusion as to a choice among different steels that will give the desired hardness.—H. W. Gillett (6)-B-

Fatigue of Single Crystals of Pure Metals. H. J. GOUGH (National Physical Laboratory, England). *First Communications of the New International Association for Testing of Materials*, Group A, Zurich, 1930, pages 134–144, 11 references.

Discussion of mode of deformation of, and propagation of, cracks under repeated stress, in single crystals of aluminum, α-iron and zinc. The direction of slip is parallel to the line of atoms in the lattice, having the most atoms per unit distance. Direction of propagation of cracks is often determined by maximum shear stress. Some theoretical discussion is given. HWG(6)

Meaning of the Notched-Bar Impact Test for Investigation and for Acceptance Test Purposes. R. H. GREAVES (Woolwich Arsenal, England). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 225–230.

Discussion of the transition zone from high to low impact figures. High figures accompany shear failure, with deformation, low ones, three-dimensional tensile stress with little deformation. The transition is affected by dimensions of test piece, form of notch, rate of loading and temperature of test. Moser's method of using specimens of 2 different breadths, does not simplify the test, but shows that change in breadth can reverse the indications of the test. The usual impact test is a better indicator in alloy than in carbon steels, the transition region with carbon steels being close to the usual conditions of test. However, a bad impact figure always indicates liability to failure under local stress. Experience shows that material that fails by cracking or fracture in service, gives poorer results in notched bar tests than material that does not fail in service. HWG(6)

Stress Analysis by Strain Gages. T. W. GREENE. *Product Engineering*, Vol. 2, Jan. 1931, pages 11–13.

Use of strain gages is described, and interpretation of resulting data for analyzing stress distributions in old and new designs set forth. Typical examples given. MFB(6)

The Safety of Rotors of High-Speed Turbo-Generators of Large Output. R. W. BAILEY & G. A. JUHLIN. *Engineering*, Vol. 130, Aug. 22, 1930, pages 242–244.

Gives details of hair crack defects and their detection in rotor forgings. Body of forging should be made longer than necessary at the end corresponding to the top of the ingot. When excess material has been removed, enough of segregate zone will be exposed to serve for adequate examination. Testing process consists in magnetizing forging, gently washing surface with stream of paraffin carrying chemically prepared, extremely finely-divided iron powder. Fine cracks are made visible by adherence of iron particles, bridging cracks under the magnetic field existing across them. Alloy steels of Ni, Ni-Cr and Ni-Cr-Mo types are liable to develop hair cracks. To produce reliable forgings attention should be given to composition, proper heat treatment and effective inspection methods. LFM(6)

Torsional-Vibration Dampers. (Annual Meeting Paper.) J. G. BAKER & J. P. DEN HARTOG. *S. A. E. Journal*, Vol. 28, Feb. 1931, pages 184–190.

In internal-combustion engines operating over a wide speed-range, critical speeds of torsional vibration cannot practically be avoided. The ensuing vibrations, if not checked, set up high alternating stresses in the shaft which have in numerous cases led to fatigue failures, many of these occurring in the crankshaft. Several devices that successfully limit these stresses to safe values during any critical speed have been developed. The fundamentals of torsional vibration and these stress-limiting devices are discussed. According to authors, stresses set up during a critical speed can be calculated in advance. Tests made on a model in the laboratory are described and the results thus obtained prove the methods of calculation to be reliable. MFB(6)

The Strength and Testing of Materials. *Metallurgist*, Sept. 27, 1929, pages 133–135.

An extensive review of Report No. 13 of the Swiss Association for Testing Materials written by P. Ludwik. See "Fatigue Tests with Construction Materials," *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. (6)

Behavior of Oxy-Acetylene Cut Material under Endurance Impact Tests. (Ueber das Verhalten von autogen geschnittenem Material bei dauernder Beanspruchung durch Schlag.) L. v. ROESSLER. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 5, 1930, pages 54–61.

Review of tests made to determine, by impact tests, the differences between machined material and material cut with oxygen, with the former taken as standard. Methods, apparatus and micrographs are given; a definite conclusion as to the better behavior under these tests could not, however, be drawn, in spite of the large number of tests made. Ha(6)

Temperature Effect. Compression and Extrusion. A. PORTEVIN. *Metallurgist*, Nov. 1929, pages 173–175.

A review of a paper previously abstracted from the *Revue de Mètallurgie*, Aug. 1929. The relationship between the behavior of a given metal or alloy under high-temperature compression test and its behavior in the extrusion press is discussed. The author obtains autographic stress-strain diagrams of 4 distinct types and an interpretation of these 4 types in terms of a single generalized pair of curves representing deformation of metal under viscous flow and under work-hardening conditions, respectively. See *Metals & Alloys*, Vol. 1, Jan. 1930, page 341. (6)

Why the Block Test for Drill Steel? OCHA POTTER. *Engineering & Mining Journal*, Vol. 129, May 23, 1930, pages 506–508.

The "block" test consists of putting a piece of steel of specified length and diameter in a rock drill with a bit about 1/4 inch from a steel anvil block and running the drill under certain standard conditions until the steel fails. The origin, development and procedure of the test method show the value of this "shop" test. Twelve details are listed of the application of the test at the Calumet and Hecla Ahmeek-Kearsage plant. WHB(6)

Further Experiments on the Magnetostriction of Over-strained Materials. J. S. RANKIN. *Journal Royal Technical College*, Glasgow, Vol. 2, Jan. 1931, pages 385–395.

Experiments are discussed and curves of results plotted for nickel rods, mild steel rods and iron wire. The magnetostrictive phenomena are tentatively ascribed to elastic internal stresses. HWG(6)

The Lubricating Properties of Mineral, Vegetable and Fatty Oils. A. S. T. THOMPSON & P. S. CALDWELL. *Journal Royal Technical College*, Glasgow, Vol. 2, Jan. 1931, pages 490–502.

While this deals with oils rather than bearings, some friction tests are tabulated for the same oils (a mineral oil, rape, castor and sperm oils) on bearing surfaces between mild steel and cast iron, mild steel and leaded bronze and cast-iron and cast-iron. With complete fluid lubrication, the nature of the bearing surfaces did not materially affect the coefficient of friction shown by the various oils. HWG(6)

Mechanical Wear. (Mechanische Abnützung.) M. SPINDEL (Railway Testing Lab., Vienna). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 113–118.

Wear resistance depends on the conditions of service, hence, tests made under different laboratory conditions will not agree. A graph is shown for laboratory tests, the conditions of which are not clearly stated. An intermediate Mn rail shows the best results next to 2 "wear resistant electric steel rails of special composition," the composition not being stated. The service results on these rails appear to agree fairly well with the laboratory tests. HWG(6)

Research on Wear Testing. (Ueber die Prüfung der mechanischen Abnützung.) DANISH STAATSPRÜFUNGSANSTALT (Copenhagen). *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 81–85.

Refers only to wear testing of cement, leather, cork, linoleum, etc. In one method, fresh sandpaper or emery paper is drawn under the specimen by mechanical means. HWG(6)

The Propagation of Large Barkausen Discontinuities along Wires. K. J. SIXTUS & L. TONKS. *Physical Review*, Vol. 35, June 1, 1930, page 1441.

Abstract of paper presented at the Apr. 26, 1930 meeting of the American Physical Society, Washington, D. C. Preisach has shown that by applying increasing tension or torsion to a wire of Ni-Fe alloy, the Barkhausen discontinuities in magnetization become larger and larger. At a tension near the elastic limit, a rectangular hysteresis loop is produced whose discontinuous change in magnetization includes 97% of the whole difference between positive and negative saturation. Langmuir suggested that this sudden change in magnetization starts at a nucleus from which it propagates along the wire. Investigation based on this view shows that the nucleus forms in a uniform field at a somewhat variable critical field strength and at different points along the wire depending, apparently, on uncontrolled factors. The nucleus can be made to form at a definite point, however, by applying locally a small additive field, and the discontinuity will then propagate into the uniform portion of the field, the strength of which can be smaller than the critical field strength. The velocity of propagation increases for a given sample with increasing field strength and tension. A 10% Ni-90% Fe wire of 0.038 cm. diameter showed velocities from 2000 to 14000 cm. sec.$^{-1}$ (6)

Determination of the Creep Limit According to the Short Time Test. (Zur Bestimmung der Dauerstandfestigkeit im Abkürzungsverfahren.) A. POMP & W. ENDERS. *Stahl und Eisen*, Vol. 5, Feb. 5, 1931, pages 157–162; *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, Report 152, pages 127–147.

Continuation of previous investigations by A. Pomp & A. Dahmen (*Mitteilungen Kaiser Wilhelm Institute für Eisenforschung*, Vol. 9, 1927, pages 33–52; *Stahl und Eisen*, Vol. 47, 1927, pages 414–415) on the determination of the creep limit by an abbreviated method, the present investigation studied the suitability of this method which has been improved in the meantime. In this method the extension is optically measured and recorded while the specimens are subjected to a load. The accuracy of these extension measurements could be essentially increased. Four straight carbon steels (C:0.06–0.61) 3 types of cast steel containing Cu and Ni and a 13.44% Cr steel were tested at 300°, 400° and 500° C. respectively. The results of the tests which in part have been extended over 240 hrs. indicate that a higher velocity of extension than 0.0003%/hr. can be applied between the 3rd and 6th hr. In alteration of Pomp and Dahmen's previous suggestions the creep limit of straight carbon steels is defined as that maximum load at which the velocity of extension does not exceed 0.0003% between the 5th and 10th hr. GN(6)

INDUSTRIAL USES & APPLICATIONS (9)

Metal Airplane Construction. FRANK M. SMITH. *S. A. E. Journal*, Vol. 28, Mar. 1931, pages 387, 392.
Recent practice in Duralumin construction described and low jig-cost revealed. (9)

The Use of Antimonial Lead for Accumulator Grids: A Cause of Self-discharge of the Negative Plates. J. T. CRENNELL & A. G. MILLIGAN. *Transactions Faraday Society*, Vol. 27, Mar. 1931, pages 103–112.
As the life of Pb storage batteries increased, it was more difficult to maintain the capacity of the negative plate owing to sulphation. The changes that occurred in the behavior of the negative plate are: (1) the rate of gas evolution, measured on open circuit, increased during the life of the cell; (2) the polarization when gassing on charge, decreased; (3) current efficiency was reduced. These changes affect the efficiency and capacity of cell and are due to lowering of overvoltage for H evolution, brought about by the deposition upon the negative grid, of Sb from the positive Sb-Pb grid. Rate of removal of Sb from positive grids is higher when the grids are older. Charging cell in opposite direction and then changing the electrolyte only brings about temporary improvement. Sb-Pb should not be used for positive grids of Pb storage batteries. PRK(9)

Blades of Rustless Steel. (Klingen aus nichtrostendem Stahl.) FRANZ BAHNER AG. *Deutsche Goldschmiede Zeitung*, Vol. 34, Feb. 21, 1931, page 4.
Rustless steel as now made makes excellent knife blades. Its general use in place of silver plated blades is predicted. JLG(9)

Alloy Spring Steels Best Meet the Requirements of Performance. *Iron Trade Review*, Vol. 86, March 19, 1930, pages 56–57.
Reprinted from *Vancoram Review*, Jan. 1930. See "Vanadium Steels for Railroad Springs," *Metals & Alloys*, Vol. 1, Oct. 1930, page 798. MS(9)

Steel Used for Fine Springs. *Metal Progress*, Vol. 1, Oct. 1930, pages 33–37.
A general review. WHK(9)

The Use of Nickel Alloy Steels in the London Omnibuses. *Nickel Bulletin*, Vol. 3, Nov. 1930, pages 347–353.
Complete specifications and numerous illustrations. MFB(9)

Wire Rope of Stainless Steel. *Power*, Vol. 73, Mar. 17, 1931, page 459.
In addition to resisting chemicals, salt water and salt air corrosion, the wire rope of chrome nickel alloy steel now being put out by the Hazard Wire Rope Co., Wilkes-Barre, Pa. under the name of "Korodless" can, it is claimed, be safely operated in temperatures up to 1650° F. As in other types of wire rope manufactured by the company, performed construction is used, the strands and wires being helically shaped to the exact form they assume in the rope structure. This construction, it is claimed, eliminates internal stress and allows the individual wires to lie side by side without undue internal friction, thus materially increasing the life of the rope. Standard sizes are available. VVK(9)

Aluminum Alloy Used in Enginehouse Doors. *Railway Age*, Vol. 90, Feb. 14, 1931, page 376.
The Norfolk & Western has recently installed 21 vertical rolling or curtain-type doors of aluminum alloy in one of its enginehouses at Williamson, W. Va. The doors are 13 ft. wide by 19 ft. 11 in. high and weigh 323 lbs. each. The slats of the doors are made from 19-gage aluminum alloy sheet and the bottom bar in each case is an angle section of the same material produced by the extrusion process. The weight is 1/3 that of similar galvanized sheet steel doors. Because of their corrosion resistance, it was not considered necessary to paint them. VVK(9)

Alloys Steels in the Railroad Field. CHARLES MCKNIGHT. *Transactions American Society Mechanical Engineers, Railroads*, Vol. 52, Sept.-Dec. 1930, pages 81–93.
There is an increasing interest in the use of alloy steels for railroads. They are used purely as a matter of economics. Better work must be done at the same cost or the same work at less cost. The use of alloy miscellaneous castings materially cuts down weight with the same strength and same cost as carbon steel castings. There are 3 ranges of steels: Carbon steels are used for special applications and semi-alloy steels, which are slightly more expensive than carbon steels and with slightly better properties as a compromise. Some of the uses include boiler materials, forgings and castings. Corrosion resisting materials, nitriding and miscellaneous materials are discussed and the economies of each are given. (9)

Some Aspects of the Uses of Fabricated Aluminium in the Chemical Industry. S. JAMIESON RALPH. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 459–464.
A review covering aluminum and its alloys. MPB(9)

Aluminum Street Cars Save One Fifth the Weight. A. M. ROBINSON. *Metal Progress*, Vol. 1, Oct. 1930, pages 53–57.
The increasing tendency to use aluminum for structural parts as well as for fittings and body sheathing results in a saving in weight of 20% and higher with attendant operating economies. WHK(9)

All Metal Sectional Houses in Use in Germany. *Metal Industry*, New York, Vol. 29, Mar. 1931, page 122.
A recent development is sectional houses of all metal construction with copper exteriors and finished sheet metal interiors. PRK(9)

The Making of Mirrors by the Deposition of Metal on Glass. *Bureau of Standards Circular* No. 389, 1931, 17 pages.
This publication supercedes Letter Circular No. 32 and deals principally with the methods for producing mirrors by the chemical decomposition of Ag on glass. The Brashear, Rochelle salt and formaldehyde formulas are given, also a detailed discussion of the precautions necessary to avoid danger, and the technique necessary to obtain the most satisfactory results. Reflecting films are produced on glass by the chemical decomposition of Cu, Pt or Pb sulphide by cathode sputtering, and by condensation of vaporized metals. WHB(9)

The Design and Manufacture of Special Steel Castings for Rolling Stock. *Canadian Foundryman*, Vol. 22, Mar. 1931, pages 10–12.
Part II of a paper presented by H. R. Bartlett before the Canadian Railway Club, of Montreal, which deals with the design and manufacture of castings for locomotives and trailer trucks. Reference is made to the largest and heaviest cast steel bed which has so far been manufactured, and which incorporated a 3-cylinder arrangement with the center cylinder on an angle. The casting weighed 82,000 pounds and was 60 ft. 4 in. long. The molding methods used in the preparation of the steel castings referred to are dealt with briefly. OWE(9)

Increasing Use of Silver in Chemical Industry. *Canadian Mining Journal*, Vol. 52, Mar. 20, 1931, pages 304, 312.
An abstract of a paper by Donald McDonald read before the Society of Chemical Industry at London. Resistance to corrosion and lowered cost have stimulated interest in Ag for use in the chemical industry. Resistance to organic acids and the use of Cu-Ag alloys and Cu with Ag rolled on for reduction of first cost of the apparatus. For the melting and casting of caustic alkalies Ag is widely used. For its use in the Drumm storage battery (alkaline electric accumulator) much higher rates of charge and discharge and a much greater capacity per unit of weight are claimed. Ag is being investigated in locomotive traction. WHB(9)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

High-pressure and Low-pressure Acetylene for Welding. (Hochdruck- und Niederdruck-Azetylen im Schweissbetriebe.) Report of the Laboratory of I. G. Farbenindustrie, Frankfurt-Main. E. ZORN. *Autogene Metallbearbeitung*, Vol. 24, Jan. 15, 1931, pages 20–25; Feb. 1, pages 35–43.
Exhaustive tests to solve the problem of the most favorable pressure of acetylene in welding with regard to the kind of burner, injector burner for low pressure, uni-pressure burner for high pressure, and also with regard to the necessary equipment, flame, capacity of welding, quality of weld, lead to the following conclusions: high pressure acetylene and the use of uni-pressure burner is better because the losses in the hose are negligible and the flame is much steadier; for the low-pressure injector burner the length of hose is of considerable influence because for long hose the oxygen is mostly in excess in order to get the necessary acetylene to the burner by the injector effect. A neutral flame with an escape velocity of about 130 m./sec. is about the most favorable condition. This most favorable condition can best be regulated and maintained with the injectorless uni-pressure burner; this burner does not require constant regulating after the first adjustment. For this reason, the acetylene under pressure has found greatest application in modern oxy-acetylene welding plants. Ha(11c)

Welding Aluminum Crank Case. T. SAKAMOTO. *Welding*, Vol. 2, Mar. 1931, page 179.
On account of the widely varying sections in the complicated casting, the whole piece was pre-heated before the welding torch was applied in order to avoid interior stresses by unequal heating. Ha(11c)

Two Interesting Welding Jobs Made in Hawaii. T. SAKAMOTO. *Welding*, Vol. 2, Jan. 1931, page 21.
Short description of work in a sugar mill. Ha(11c)

Recent Application of Welding for Heating Plants. (Neuzeitliche Anwendung der Schweisstechnik bei der Installation von Heizungsanlagen.) HELLMUT SCHEEL. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 61–63.
Description of distribution pipe lines in basements, hot-houses, industrial plants and residences which can be made economically by welding. Ha(11c)

Welding Insures Strength and Beauty. J. A. SCHAEFER. *Welding*, Vol. 2, Mar. 1931, pages 185–187.
The Dreix & Krump Co. make all their master tools used in sheet work of welded steel. Ha(11c)

Welding of Heating Pipe Lines. (Schweissungen von Fernheizleitungen.) HERM. RICHTER. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 55–57.
Description of welding for central heating plants with long pipe lines. Ha(11c)

Atomic Hydrogen Welding. C. I. MACGUFFIE. *Baltimore Engineer*, Vol. 5, Aug. 1930, pages 15–16.
General notes on development process and equipment. (11c)

A Modern Method of Training Welders. W. D. PATTERSON. *Welding*, Vol. 2, Jan. 1931, pages 15–17.
The course of the American School of Welding, Inc., St. Louis, Mo., requires 245 hours. Short description of the course which comprises both electric and oxy-acetylene welding. Ha(11c)

Facts Concerning Welding of Rail Ends. S. E. TRACY. *Welding*, Vol. 2, Feb. 1931, pages 114–118.
Building up battered rail ends is of extreme importance in the maintenance of railroad tracks from the point of view of safety and economy. The Chicago, Burlington & Quincy Railroad has used welded rail joints extensively. The principal methods are described and hardness tests are given. The cost per joint was $2.0144 for electrically welded ends, while only $0.81 for welds with oxy-acetylene; the difference is due mainly to the costlier equipment and greater amount of labor required. Ha(11c)

Design of Welded Crane Columns. C. M. TAYLOR. *Welding*, Vol. 2, Feb. 1931, pages 107–109.
Some simplified structural details are described which make a strong and rigid construction economical to erect. Ha(11c)

Welding Technique and Heating Industry. (Die Schweisstechnik und das Heizungsgewerbe.) P. THELEN. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, page 52.
Remarks on progress made in the manufacture of tanks, boilers and radiators for heating purposes by welding. Ha(11c)

Stress Relieving Improves Welded Machine Parts. G. D. SPACKMAN (Lukenweld, Inc.). *Steel*, Vol. 87, Nov. 20, 1930, pages 62–63.
The cases in which residual stress is so objectionable that it is necessary to stress relieve the whole structure in a furnace are: (1) residual stress which results in unit loads possibly twice as great as the loads for which the stressed member was designed; (2) residual stress which causes warping beyond permissible limits; and (3) residual stress which results in warping of the piece beyond permissible limits during machining operations. In general, appreciable residual stress is left in a welded joint when there is more weld metal on one side of the center than on the other. MS(11c)

Gas Welding and Cutting for Garage Profits. *Welding*, Vol. 2, Apr. 1931, pages 243–245.
If a garage is equipped with welding outfits, profits can be increased by taking in outside work of crankcase and cylinder block repairs, building of trailers, fenders, etc. Ha(11c)

The Bronze Welding of Cast Iron Pipe. *Welding*, Vol. 2, Apr. 1931, pages 235–237, 241.
The advantage of this method is pointed out and illustrated with two recently completed water pipe lines. Instructions are given for carrying out this technique correctly. Ha(11c)

Two Portable Arc-Welders. *Welding*, Vol. 2, Mar. 1931, pages 192–193.
Dynamo of 300-amp. continuous capacity mounted on Ford truck and driven by its engine, built by the Shrader Elec. Co., Los Angles, Cal. Ha(11c)

Bed of Pipe Machine Assembled by Welding. *Welding*, Vol. 2, Mar. 1931, pages 190–191.
Special machine of the Moline Tool Co. for boring, hollow milling and threading of long sections of pipe. Total weight, 6000 lbs. Ha(11c)

Templet for Fabricating Bends in Large Pipes. *Welding*, Vol. 2, Jan. 1931, pages 43–44.
Description of a method useful in the field. Ha(11c)

Testing Sheet Steel for Weldability. *Welding*, Vol. 2, Jan. 1931, page 43.
To find whether a particular piece of sheet is suitable for oxy-acetylene welding, the following test is recommended: a piece about 6-in. square is blown with a neutral flame to melting for about 3-in. length and a hole burnt. If the quality is good, no excess of oxide or scale will be noticeable and the upper side will be smooth. Ha(11c)

New San Diego Water Line is Arc-Welded. *Welding*, Vol. 2, Jan. 1931, pages 42–43.
About 86,000 ft. of 40" and 36" pipe over and through hills, of a wall thickness of 1/4" to 3/16." Ha(11c)

Fundamentals of Resistance Welding. TH. D. KETCHBAW. *Welding*, Vol. 2, Jan. 1931, pages 40–41.

General remarks on current used, machine construction, function of transformer and preparation of the work. Ha(11c)

Acetylene Welder's Manual. (Leitfaden für Acetylenschweisser.) THEO. KAUTNY. Carl Marhold Verlagsbuchhandlung, Halle a. d. S., 1930. Cloth, 5 × 7 inches, 256 pages. Price 5.20 RM.

This compact little manual brings, in a very condensed but yet sufficiently clear and correct manner, everything that a practical man needs for the understanding of the nature of welding processes, preparation of the material, selection of methods and materials; in short, everything pertaining to this art—but nothing that is not just as well treated in American handbooks. Worthy of recommendation is the chapter on the welding of nonferrous materials, which is very complete and, also, deals with some metals, not essentially of industrial use.—M. Hartenheim (11c)-B-

Practical Acetylene Welding Manual. (Manuel Pratique de Soudure Autogene.) R. GRANJON & P. ROSEMBERG. Dunod, Paris, 1929. Paper, $5^1/_2 \times 8^1/_2$ in., 410 pages. Price 31.60 Fr.

For this manual, the very same remarks could be made as for the foregoing German manual. Beside the same matter, it contains a few more calculations and a few more drawings to show the preparation, step by step, of the pieces to be welded. A large amount of space, not without reason, has been devoted to the execution of repair work. It is one more complete treatise of this art, of which there are already so many on the market. This is, however, by no means meant as derogatory to its value for French welders.—M. Hartenheim (11c)-B-

Practical Oxy-Acetylene Welding. R. GRANJON, P. ROSEMBERG & A. DESGRANGES. *The Welding Journal*, London, 1929. Paper, $5 \times 7^1/_4$ inches, 181 pages. Price 3/6 sh.

Translated from the French. It is very questionable if there was, in view of the lately rising flood of publications on welding in the home market, an urgent necessity for the translation of a French manual. This is even more true, since this manual contains quite a few examples of American practice and quotations from American literature. Its completeness, in every respect, cannot be denied, although the arrangement of material in the original seems preferable to that in the translation.—M. Hartenheim (11c)-B-

The "Carolinian," an All-Welded Ship. ELLIOT HARRINGTON & O. A. TILTON. *Welding*, Vol. 2, Jan. 1931, pages 18–20.

Short description with illustrations of the methods used which, it is claimed, saved 20% in weight and 25% in cost. The ship is an oil-tanker 120 ft. long and 23 ft. beam. Ha(11c)

Detection and Fixation of Tension-Fissures in Welds. (Auffindung und Darstellung von Spannungsrissen an Schweissungen.) H. KEMPER. *Autogene Metallbearbeitung*, Vol. 24, Feb. 15, 1931, pages 57–60.

Two methods are described which permit the detection and recording of the finest cracks in welds: (1) The penetration method, using light oils to make the cracks visible. It can be applied without smoothing the seam over. A thin oil is brushed on the weld and left there for a while so that it penetrates into the fine fissures by capillary action. The superfluous oil is wiped off and a solution of calcium carbonate (chalk) in alcohol is brushed on. As the alcohol evaporates quickly, a coating of chalk remains which absorbs some of the oil in the cracks and thus clearly shows the size and location of cracks. (2) The sulphur-print method. Here, the crush of the weld seam must be removed. The weld is covered with a dilute sulphide solution which penetrates into the fine cracks. After cleaning thoroughly, a piece of paper sensitized with silver bromide and dipped in a 5% solution of H_2SO_4 is pressed onto the place for about a minute after which the sulphide solution in the cracks blackens the paper which shows the cracks as fine lines. These prints can be developed and fixed in the usual manner. These methods have been used in the laboratory of Chemische Reichsanstalt. Ha(11c)

Construction of Welded Girders. (Ausbildung geschweisster Blechträger.) H. GOTTFELDT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Dec. 27, 1930, pages 1755–1757.

The characteristic difference between a riveted and a welded girder plate consists in that, for the latter, no angle irons are required for joining the flange plates to the web. Based on this difference, the different possibilities of forming the sections are thoroughly treated, namely the arrangement of several plates one upon the other or plates of different thicknesses butted together. The order of the welds and the most suitable gradation of the section of the reinforcing plates are discussed and the various forms critically treated. Ha(11c)

Method of Erecting Welded Arch Buildings. R. L. GRAVELEY. *Welding*, Vol. 2, Mar. 1931, pages 175–176.

Deals with the design of arches, methods of erecting, types of welds used and system of inspection, by the Arch Engineering & Construction Co., Orlando, Fla. Ha(11c)

Fillet Welds Determined Graphically. JAMES R. GRIFFITH. *Welding*, Vol. 2, Mar. 1931, pages 163–165.

A monographic chart was developed which permits the determination of any of the 4 factors: unit shearing force, total load, total length of weld and size of fillet. Ha(11c)

Oxy-Acetylene Welding for Aircraft. LEROY R. GURLEY. *Welding*, Vol. 2, Feb. 1931, pages 95–96.

Proper procedure control removes the human element and places the responsibility for good welds on designer and inspector. Ha(11c)

Computing Fillet Weld Stresses. CHAS. H. JENNINGS. *Welding*, Vol. 2, Feb. 1931, pages 101–104.

Three methods are used at present for calculating the stresses occurring in fillet welds: (1) the conventional method, in which the weld is considered to transmit the load over its whole section; (2) the principal stress method, consisting mostly of tension or shear; (3) the resultant force method, which is the resultant force acting in the weld in order to develop the force in the individual members. These methods are analytically discussed; from the standpoint of obtaining satisfactory results, they can be arranged in the order 2-1-3. On account of the wide varieties in the results of the methods the author advocates the establishment of a definite method as soon as possible. Ha(11c)

Weld Design and Production. ROBERT KINKEAD. Ronald Press, New York, 1930. Cloth, $6 \times 8^1/_2$ inches, 108 pages. Price $4.00.

Users and, especially, prospective users of welding methods for joining parts of their production will find this book an excellent guide in forming their judgment as to when and how to employ this process. There is no question but that welding is, to-day, almost superseding every other form of joining parts and the fundamental, essential understanding of the behavior of welded joints—how to prepare, what to expect and how stresses can be calculated—is simply, but clearly, set forth by the author. Manual and automatic welding is discussed. The space dimension diagrams are a very good means of obtaining an insight into the distribution of stresses. Very timely is the chapter on "Research and Development," wherein the author points to the often-neglected importance of the choice of a personnel to carry on research work. Failures in this field can easily be traced to the improper selection of personnel. The good printing makes this treatise the more readable.—M. Hartenheim (11c)-B-

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Common Errors in Steel-Making. WALTER LISTER. *Metallurgia*, Vol. 1, Dec. 1929, pages 79–80; Jan. 1930, pages 103–104; Feb. 1930, pages 158–160 and 165; Mar. 1930, pages 200–202 and 214; April 1930, pages 247–249.

Discusses manufacture of steel in acid and basic open-hearths. The form of molds and casting practice is discussed. Methods for marking ingots and keeping records are given. JLG(12a)

Process Reliability in Steel Making. GEORGE A. DORNIN (Gathmann Engineering Co.) *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 100–128.

Paper presented before the 12th annual Convention of the Society in Chicago, Sept. 1930, with discussion. The author refers to 4 essentials for sound steel: (1) deoxidized bath before teeming; (2) ingot mold of proper dimensions; (3) keeping the ingot in a vertical position until completely solid; and (4) a refractory sinkhead, which he presented some years ago. He now proposes to amplify the first, the second and third stand with only slight modification and the fourth while not fundamentally essential is commercially necessary. The author refers to lack of control over the processes, by which large tonnages of steel are made, leading to unreliable metal. It is pointed out that the use of tests cannot be made to control an unreliable process. The results of substitution of basic process for the more reliable acid open hearth process in making cable for the Mount Hope Bridge is cited. Rimming steel, killing in the mold with Al, use of big end down molds, and welding are condemned as not reliable or susceptible of control. The author discusses his 4 fundamentals in detail and offers a duplex open-hearth process using a neutral slag for finishing as the solution of the first, the big end up type of mold is proper shape to prevent internal bridging and voids, failure to allow sufficient time for complete solidification results in woody structure, the refractory sinkhead feeds the shrinkage cavity and maintains a ferrostatic pressure on the crystal bridges and keeps them bent down. Shape of ingot section is discussed. In discussion H. H. Ashdown, Consulting Metallurgist, takes exception to fundamentals 2 and 4 and suggests the addition of "except under special conditions." W. H. White, Duquesne Steel Foundry, suggests the necessity for improvement in the personnel as well as in the process. T. M. Jasper, A. O. Smith Corp., finds much of the author's criticism of unreliable steel making methods is warranted by the experience of consumers. W. J. Priestley, Electro-Metallurgical Sales Corp. points out desirability of the properties of rimmed steels for certain applications and emphasizes the cost to the steel maker who must operate at a profit. WLC(12a)

Use of Zirconium Alloys in Steel Making. (De l'emploi des alliages au Zirconium dans la fabrication des aciers.) PH. GUY. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Nov. 1930, pages 509–521.

Ferro-silico-zirconium alloy has been used as deoxidizer and as alloying addition to steel. Zirconium has the property to form nitrides and to fix the sulphur, which is about $^1/_{10}$ of the amount of the zirconium added. The ratio Mn/S is reduced by the addition of Zr. Steels treated with only 0.04% Zr show an endurance limit higher than the steel treated with only FeSi. The effect of Zr on Izod number neutralizes that of phosphorus. GTM(12a)

New Manganese-Silicon Alloys for the Deoxidation of Steel. C. H. HERTY, JR. & G. R. FITTERER. *Bureau of Mines Report of Investigations* 3081, Feb. 1931, 14 pages.

By using manganese-silicon alloys for deoxidation, larger inclusions were formed than when using silicon alone. The average size of the inclusions formed when using silicon was 15 cm. $\times 10^{-4}$. The size increased with increasing manganese, until at a Mn/Si ratio of 4.18 the largest particles in dead-killed steels were 1000 cm. $\times 10^{-4}$. These large particles would rise at a much more rapid rate (600 to 2400 inches per minute) than the small silica particles (0.15 to 1.5 inches per minute). Tests in commercial acid or basic open hearths show the same results on steels from 0.12 to 0.60% C using alloys with a Mn/Si ratio of 4.5 to 6.0. Manganese efficiencies of 75 to 85% have been obtained when forging grade steels have been deoxidized with these alloys. AHE(12a)

Refining of Aluminum and Its Alloys by Treatment with Chlorine and Nitrogen. (Raffination von Aluminium und seinen Legierungen durch Behandlung mit Chlorgas und Stickstoff.) W. KOCH. *Metallwirtschaft*, Vol. 10, Jan. 23, 1931, pages 69–72; Jan. 30, 1931, pages 85–88.

Contains 5 references. Chlorine gas was passed for 5 to 15 minutes through molten Al alloys at 700° to 1100° C. The alloys contained from 0.8 to 12.6% Fe, 0.41 to 2.1% Si and 1.4 to 2.8% Cr. Silumin and commercial Al scrap were also treated. During the first few minutes Cl is absorbed by the metal, then the Cl escapes and some metal is also volatilized, but a protective coating forms on top of the metal. After treatment with Cl, N was passed through the metal to free it from Cl. The change in Fe and Si content due to this treatment is very slight. The effect of the Cl and N treatment is to reduce the gas content of the alloys considerably, purify the crystal boundaries, reduce the grain size and make it more uniform, increase the fluidity, produce tight, smooth castings with a fine fracture and raise the tensile strength, ductility and hardness. The best temperature for chlorinating is about 100° above the melting point of the alloy and the best time 7 to 8 minutes for a 10-lb. heat. The refining action of Cl is explained by the slight solubility of Al in Cl and the affinity of Cl for the metalloid impurities and the volatility of the chlorides formed. The process has commercial possibilities in the purification of Al scrap. CEM(12a)

DEFECTS (13)

Discontinuities. *Metallurgist*, Feb. 1931, pages 18–19.

The ill effects of sudden or sharp changes of section in any metallic part exposed to stress are, in principle, very fully recognized; yet practice frequently falls short of theoretical requirements in this direction. No doubt this is due to the fact that the requirements of design, or at all events the convenience of the designer, frequently seem to call for sharp "corners," especially in machine parts where the provision of a fillet of adequate radius entails a certain degree of awkwardness of construction. Moreover the addition of a considerable weight of metal to the parts in question to take care of any concentration of stress that may occur, may even aggravate the evil. Coker, in discussing Freeman's paper on the strength of welded joints recently given before the Institution of Civil Engineers, pointed out that where 2 overlapped pieces of steel are connected by fillet welds the interface of the 2 pieces acts practically as a crack or fissure and produces a stress concentration at the end of the fissure—i. e., at the weld itself. This stress concentration can, no doubt, be overcome by the adoption of a more rational form of welded joint, but its very existence has in all probability remained unrealized by those concerned with the design of welded joints. Heavy cuts in rough machining operations may leave a series of minute saw teeth at the roots of which there is often a fine fissure running a short distance into the metal. As a rule these are removed by the finer finishing cut but this is not always possible. Non-metallic enclosures, particularly when placed in a dangerous position, may initiate a fatigue crack. The number of non-metallic enclosures could be materially reduced if steel makers could be induced to lay stress on this aspect of their manufacture. VVK(13)

Non-Metallic Inclusions in Steel. I. S. GAIEFF. *Metallurgist*, Leningrad, Russia, No. 3, 1929, pages 369–399 (in Russian).

In a rather comprehensive paper, the author discusses the methods of preparation of specimens (grinding, polishing), the nature of inclusions, the methods of their identification and their effect on the structure and properties of metal. He divides non-metallic inclusions into the following main classes: (1) oxides, (2) sulphides, (3) silicates and slag inclusions. The color of inclusions, their hardness as well as the power to reflect light and their reaction to the action of the various etching reagents are used for identification of the nature of inclusion. It may be pointed out that at present there are about 40 chemical reagents used in mineralography. The author calls attention to the phenomena of diffusion of certain inclusions. If we take for example, a steel containing about 1% S and showing very fine particles of FeS, if we soak this steel for several hours at 1200° C. and cool slowly, we find that FeS inclusions disappear and instead of them flakes of Fe S are present. These flakes are arranged, sometimes, in a network manner. According to M. K. Ziegler, the rate of diffusion of sulphides at 1300° C. is of the following order: for FeS, 0.110 mm./hr.; for MnS, 0.003 mm./hr.; and for Mn S + Fe S an intermediate figure. In case of silicates, there were observed bands 0.005 mm. thick separating inclusions from the base metal. The author thinks that the presence of such "diffusion Zones" supports the suggestion made by Wohrman (Inclusions in Iron. C. R. Wohrman. *Transactions American Society for Steel Treating*, Vol. 14, 1928, pages 255–299.) that molten Fe is capable of being "silicatized." Sometimes non-metallic inclusions are present as the thin films surrounding the grains of the metal. Such films usually may be detected only under high magnifications (1000–2000 magnification). Examples are cited which show that inclusions serve as the nuclei upon which ferrite, cementite or troostite may be deposited. The paper is illustrated with many micrographs and contains 186 references. AIK(13)

CHEMICAL ANALYSIS (14)

Preparation of Some Organo-Mercuric Nitrates, and a Method of Analysis for Mercury Applicable to Dilute Solutions of Such Compounds. I. B. JOHNS, W. D. PETERSON & R. M. HIXON. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2820–2822.

A rapid method of analysis for mercury in the type compounds RHgX is described which is satisfactory even in the presence of iodides. MEH(14)

The Iodimetric Determination of Small Amounts of Zinc. H. ARMIN PAGEL & OLIVER C. AMES. *Journal American Chemical Society*, Vol. 52, Aug. 1930, pages 3093–3098.

Small amounts of zinc (3 to 33 mg. in 100 cc.) are precipitated as zinc pyridine thiocyanate, the thiocyanate treated with small excess of standard iodine and made alkaline with borax, and finally the solution is acidified and the excess iodine titrated with thiosulphate. Interferences of other metals and the details of the procedure are included. MEH(14)

The Detection and Estimation of Small Amounts of Lithium. EARLE R. CALEY. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2754–2758.

The method is based upon the reaction between ammonium stearate and lithium chloride in amyl alcohol solution and is a turbidometric procedure. Greater accuracy is claimed for this than for the gravimetric, when small amounts are to be estimated. MEH(14)

A Method for the Separation and Gravimetric Determination of Osmium. RALEIGH GILCHRIST. *Bureau of Standards Journal of Research*, Vol. 6, Mar. 1931, pages 421–448.

A procedure for the separation and gravimetric determination of Os is described. This procedure involves the separation of Os from other metals by distillation as the volatile tetroxide and its recovery from solution by hydrolytic precipitation. A very suitable reagent for the quantitative absorption of the distilled tetroxide was found to be 6 N HCl saturated with SiO_2. The recovery of Os was accomplished by precipitating the hydrated dioxide from a boiling solution at acidities ranging from pH 1.5–6.3, after sulphite compounds had been decomposed by repeated evaporation with HCl. The hydrated dioxide was impregnated with NH_4Cl to prevent mechanical loss when ignited to metal under hydrogen. The thiourea test devised by Chugaev for the detection of small quantities of Os was modified so that it could be applied to solutions containing HNO_3. The test was found to be sensitive to 1 part in 5,000,000 parts of solution, which is 50 times as sensitive as stated by Chugaev. (14)

Spectrographic Analysis Valuable in the Steel Plant. KELLERMANN. *Iron Age*, Vol. 126, August 7, 1930, page 359.

Abstract translation from *Stahl und Eisen*, Oct. 17, 1929. See *Metals & Alloys*, Vol. 1, July 1930, page 634. VSP(14)

HISTORICAL & BIOGRAPHICAL (15)

How the Nickel Industry Started Fifty Years Ago. E. A. COLLINS (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1930, pages 426–428.

An historical review. WHB(15)

Rhodesian Manganese Mines of 7000 Years Ago. RAYMOND DENT. *Canadian Mining Journal*, Vol. 52, Feb. 6, 1931, pages 150–151.

A reference to the mines in the district east of Broken Hill covering the primitive uses of minerals, the discovery of these mines and the uses of Mn in early civilizations. WHB(15)

An Investigation of the Microstructures of Fifteen Silver Greek Coins (500–300 B.C.) and Some Forgeries. C. F. ELAM (Newnham College, Cambridge). *Institute of Metals, Advance Copy* No. 550, 1931, 10 pages.

All of the genuine coins had been struck, while only one of the forgeries showed any indication of striking. Some of the coins had apparently been struck hot. Treatment differed at different mints. Analyses indicate that Cu had been intentionally added. 7 references. JLG(15)

The Magnesium Industry. JOHN A. GANN (Dow Chemical Co.). *Industrial & Engineering Chemistry*, Vol. 22, July 1930, pages 694–700.

A review of the magnesium industry in celebration of the 100th birthday of the metal. Herein are treated the history, manufacture, foundry practice, fabrication, corrosion resistance and protection, uses and commercial alloys of magnesium. 9 references. MEH(15)

Sixty Years Ago—Nickel. 1870–1930. *Engineering & Mining Journal*, Vol. 130, Aug. 9, 1930, page 126.

An historical note on nickel in 1869, dealing with occurrences in the East. WHB(15)

Advances in Metallurgy. WARREN C. DAVIS. *Canadian Mining Journal*, Vol. 51, Aug. 29, 1930, pages 836–837.

A brief outline. "Necessity is the Mother of Research." WHB(15)

The Development of Wire Rope. P. C. CLARK. *Wire & Wire Products*, Vol. 5, Dec. 1930, pages 457–459, 482–483; Vol. 6, Jan. 1931, pages 12–13, 34–35.

Historical development of wire rope making. GN(15)

Who Invented Stainless Steel? (Wer hat den rostsicheren Stahl geschaffen?) E. MAURER (Freiberg). *Reprint, Technischen Blättern des deutschen Bergwerks-Zeitung*, Vol. 21, Nos. 12 and 13, 15 pages.

Polemic and historical discussion. While Hadfield, Guillet and Giesen (Maurer does not mention Becket, see *Mining & Metallurgy*, Vol. 9, 1928, page 551; Vol. 10, 1929, page 10) had made chromium steels that would have rust-resisting properties, they did not recognize those properties, and Monnartz, working under W. Borchers in 1908, may have been the first to recognize them. Maurer considers that Borchers and Monnartz, Dubois and Preher and Friend, Bentley and West marked out the way, and that Brearley, Hummelberger, Mauermann and Maurer all developed stainless steel independently. Maurer states that the other 3 antedated Brearley, but priority among the other 3 is not clear. However, Maurer feels that the finding of the suitable heat-treatment for making the steel fully corrosion-resistant, which he claims for himself, on the basis of experiments with Mn steel, was the crux of the whole matter. Other names mentioned in the history of Cr or Ni-Cr alloy steels are Pasel, Haynes, Berthier, Woods, Clark, Boussingault, Erdmann, Marsh, Dempster, Strauss, Goerens, Popp, R. Borchers, Dumas. The Pasel patents No. 304,126 and No. 304,159, of 1912 in Germany, appear to be the first clearly covering the present 18 Cr 8 Ni combination, with heat-treatment by quenching from 1100–1200° C., among those mentioned by Maurer, but Maurer claims that this heat-treatment would follow directly from his own. HWG(15)

ECONOMIC (16)

Mercury in 1929. PAUL M. TYLER. *Mineral Resources of the United States*, 1929, Part 1, Dec. 18, 1930, *United States Bureau of Mines*, pages 117–142.

In 1929 continued high prices stimulated activity in Hg mining and resulted in further increase in production from 17,870 flasks (1928) to 23,682 flasks of 76 lbs., derived from 63 mines. California led with 10,139 flasks, followed by Nevada with 4764, Oregon 3657, Washington 1397 and Texas, Arizona and Alaska 3725. A valuable survey of distribution of consumption is given. Drugs and chemicals account for 40% of the consumption and fulminate for blasting caps for 19%. No new uses were developed in 1929 except in Hg-containing solder reported in Great Britian. Production by states is discussed in detail. AHE(16)

The Present Situation of Aluminum Industry. (Situation de l'industrie de l'aluminium.) *Journal du Four Electrique*, Vol. 40, Jan. 1931, pages 14–15.

Aluminum industry did suffer in 1930, but not as much as that of most of the other metals. Producing and consuming countries were in better position than the exporters, particularly when tariff walls were introduced all around. JDG(16)

Preliminary Report on Goudreau and Michipicoten Areas. E. S. MOORE. *Canadian Minining Journal*, Vol. 51, Dec. 19, 1930, page 1224.

Gold developments of the season and drilling of Fe ore deposits are briefly outlined. WHB(16)

Chromite in 1929. LEWIS A. SMITH. *Mineral Resources of the United States*, 1929, Part 1, Mar. 5, 1931, *United States Bureau of Mines*, pages 203–229.

The United States produces a negligible quantity of chromite and imports over half the world's output. In 1929, 318,000 tons were imported, an increase of 101,000 tons over 1928. The outstanding metallurgical development was the increased use of Nirosta metal (18% Cr and 8% Ni in iron). The chromium-plating industry increased its production in 1929. In the United States 543 tons of chromite were mined (269 tons shipped). Details are given. 30 references. AHE(16)

Quinquennial Review of the Mineral Production of India for the Years 1924 to 1928. *Records of the Geological Survey of India*, Vol. 64, 1930, 446 pages.

Introduction. E. H. PASCOE, pages 1 to 3.

Summary of Progress. E. H. PASCOE, pages 4 to 25.

The output and value of all minerals and metals produced in India and imported into the country in 1924 to 1928 are tabulated.

Antimony. E. H. PASCOE, pages 26 to 28.

Antimonial lead (about 1000 tons a year) is being regularly produced from the Bawdwin mine in Burma. It analyzes approximately 77% Pb, 21% Sb and 6 to 8 oz. of Ag/ton.

Copper. E. H. PASCOE, pages 78 to 88.

Indian Cu production from 1924 to 1928 averaged about 20,000 tons per year.

Gold. G. DE P. COTTER, pages 92 to 106.

Indian gold production has been falling steadily since 1915. Average production for 1924 to 1928 was about 387,000 ounces.

Ilmenite. W. A. K. CHRISTIE, pages 109 to 111.

India is the world's largest producer of ilmenite.

Iron. H. CECIL JONES, pages 111 to 146.

The advance in the Indian iron and steel trade during this period was less than expected. Iron ore production averaged over 1,700,000 tons. The operations of individual steel companies are described.

Lead. G. VERNON HOBSON, pages 154 to 166.

The Bawdwin mine of the Burma Corporation is one of the greatest lead-silver-zinc mines in the world. Production from 1924 to 1928 averaged about 60,000 tons of Pb and nearly $5^3/_4$ million oz. of Ag.

Manganese. L. L. FERMOR, pages 172 to 233.

India is the world's leading manganese producer. The world economic situation is discussed.

Silver. G. VERNON HOBSON, pages 293 to 298.

Over 99% of the Ag production in India is from Pb ore. The government Ag refinery is described in detail.

Tin. J. COGGIN BROWN, pages 298 to 305.

The tin industry has steadily progressed during this period.

Tungsten. J. COGGIN BROWN, pages 305 to 310.

Burma tungsten production, inflated during the war, has collapsed.

Zinc. G. VERNON HOBSON, pages 310 to 312.

Zinc concentrates are produced at Bawdwin. Their amount is steadily increasing.

Arsenic. E. H. PASCOE, pages 320 to 322.

Bismuth. E. H. PASCOE, page 344.

Cobalt. E. H. PASCOE, pages 379 to 380.

There is a regular (small) production of cobalt from nickel speiss from the Burma Corporation.

Nickel. E. H. PASCOE, pages 412 to 413.

Nickel is a by-product in the smelting operations of the Burma Corporation.

Rare Minerals. W. A. K. CHRISTIE, pages 421 to 426.

Occurrences of platinum, iridosmine, molybdenite, rutite, beryl, various minerals of the rare earths, etc., are described. AHE(16)

Ore Deposits in Algeria. (Erzvorkommen in Algerien.) W. LUYKEN. *Stahl und Eisen*, Vol. 51, Jan. 22, 1931, pages 110–111.

An article by G. Bétier in *Revue de l'Industrie minérale*, 1930, pages 313–371, is reviewed. The origin and the amount of the ore deposits is discussed. GN(16)

PLANTS & LABORATORIES (17)

The Huntington Rolling Mill. H. S. ARNOLD & SHOFFSTALL (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1930, pages 493–494.

A description of the Huntington, W. Va., plant of the International Nickel Co. The raw materials employed are: Ni-Cu matte from the Canadian smelter and electrolytic Ni cathodes from the Port Colborne refinery. The final products are: Monel metal, and malleable Ni in the form of bars, rods, wire strip, sheets and tubes of all ordinary dimensions. A flowsheet is shown. WHB(17)

Lathe Transmission Gears. DONALD M. GURNEY. *Metal Progress*, Vol. 1, Sept. 1930, pages 68–70.

A description of production hardening methods used by the Warner and Swasey Co. in the manufacture of gears. A straight line installation of 2 salt pots, quenching oil tank, detergent kettle and air tempering furnace, served by a monorail air hoist constitute a unit of 250 lbs./hr. capacity. The steel used is S.A.E. 3150. WHK(17)

European Laboratories for the Testing of Materials. FRANKLIN L. EVERETT. *Mechanical Engineering*, Vol. 53, Mar. 1931, pages 201–204.

Observations covering the more important British and continental university and industrial laboratories devoted principally to research in the mechanics of materials. MFB(17)

British Insulated, a Great Cable Company. A. C. BLACKALL. *Wire & Wire Products*, Vol. 5, Oct. 1930, pages 422–423, 439–441.

Description of the plant, methods, equipment and products of the largest English cable making company. GN(17)

The Cardiff Blast Furnace Plant of the British (Guest Keens) Iron and Steel Company Limited. *Iron & Steel of Canada*, Vol. 14, Jan. 1931, pages 6–8.

A description of the blast-furnace plant and, in particular, of the No. 4 blast furnace recently erected at Cardiff, South Wales. This furnace was responsible for a record output of 4008 tons of iron in one week. A full description is given of the charging gear, main hoist, gas-cleaning equipment, stoves, casting equipment, blowing plant, boiler plant and raw materials used in manufacture of the iron. OWE(17)

A New Plant for Carburetor Production. *Brass World*, Vol. 27, Mar. 1931, pages 53–55.

An illustrated description of the foundry and machine shops at South Bend, Ind., of the Stromberg Motor Devices Co. Automotive and aircraft carburetors are made. WHB(17)

New Type of Deep Galvanizing Installation in Canadian Plant. *American Metal Market*, Vol. 38, Mar. 3, 1931, page 5.

At the Frost Steel & Wire Co., Hamilton, Ontario, an electrically-heated hot-dip galvanizing furnace features deep kettles with heat application at determined positions on the sides which result in great reductions in residuum losses and a uniformity in technique. The furnace which is illustrated lends itself to fully automatic and absolute control of temperature of 30–35 tons of molten zinc in the large kettle. A very superior product from the standpoint of bonding of zinc to the wire is claimed. WHB(17)

Precious-Metal Worker Uses Ten Electric Furnaces. *Electrical World*, Vol. 97, Feb. 21, 1931, pages 368–70.

At the plant of the D. E. Makepeace Co., Attleboro, Mass. ten electric furnaces are used for melting, annealing and tool hardening of Pt, Au and Ag alloys and of Au and Ag solders. The advantages of the electrically-heated over the fuel-fired annealing furnaces are freedom from oxidation and from sulphides on the surface of the Ag alloys. Direct annealing is applied by taking from a separate single-phase, 500-volt feeder, which is stepped down through a special transformer and a number of secondary taps to voltages varying between 8 and 64. Control of the secondary voltage is made by means of a set of removable busbars in combination with two sets of knife switches. Wiring details of the control panel are shown. WHB(17)

The Electrolytic Copper Refinery at Oolen. (La raffinerie electrolytique de cuivre d'Oolen.) R. SEVIN. *Journal du Four Electrique*, Vol. 40, Jan. 1931, pages 9–10.

A brief description of the most modern European copper refinery with a present capacity of 75,000 tons a year. No radical innovations were introduced in the design, but everything was planned according to the best practice. Another division of the plant handles preparation of bichromate and recovery of cobalt and radium. JDG(17)

Continuous Billet Normalizing Furnaces. C. B. PHILLIPS (Surface Combustion Co.). *Blast Furnace & Steel Plant*, Vol. 18, Mar. 1930, pages 452–453; *Heat Treating & Forging*, Vol. 16, June 1930, pages 781–782.

Describes a continuous, double-row, pusher-type, gas-fired billet heating furnace. It has preheating, heating and soaking zones, the parts being heated to 2300° F. It is provided with automatic combustion control. The normalizing furnace is of the same general type as the billet furnace. The highest temperature used in it is 1650° F. See also "Forging Practice Modernized by Mechanical Handling" in *Metals & Alloys*, Vol. 2, Jan. 1931, page 14. MS(17)

The New 5000-Ton Smelter. D. MACASKILL & R.M. COLEMAN (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1931, pages 473–477.

An illustrated description of the new International Nickel Co. smelter at Copper Cliff. Detailed flow sheets of the operations from the Frood and Creighton mines to the refinery are included. WHB(17)

MISCELLANEOUS (20)

On the Nature of Tensile Strength. (Ueber die Natur der Festigkeit.) H. KOTTE. *Stahl und Eisen*, Vol. 50, July 24, 1930, page 1071.

An article by M. Polanyi in *Metallwirtschaft*, Vol. 9, 1930, pages 553–558, on the above subject is reviewed. A general discussion of the difference between amorphous and crystalline state is given, pointing out that crystalline bodies have a distinct arrangement of atoms whereas amorphous bodies are distinguished by a non-uniform atom arrangement. This distinction then causes a different behavior in any process of deformation. Amorphous bodies cannot form sliding planes in deformation. The plasticity of amorphous substances is extremely dependent upon the temperature. GN(20)

Progress and Future of Chemical Engineering in Australia. N. V. S. KNIBBS. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 431–432.

Brief survey, metallurgical industries included. MPB(20)

Calculation of the Turning Moment of a Converter. (Die Ermittlung des Kippmonentes eines Konverters.) H. KÖNIG. *Archiv für Eisenhüttenwesen*, Vol. 4, Oct. 1930, pages 177–184.

Report 193 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The author finds through mathematical calculations that the axis of suspension of converters is almost always placed too high. He shows that over 50% of the hydraulic power can be saved in the example considered. GN(20)

Chemical Engineering in South Africa. WM. CULLEN. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 429–430.

Brief description, metallurgical industries included. MPB(20)

The Hardening of Superhardened Steel by Magnetism; the Lattice-Resonance Hypothesis. E. G. HERBERT. *Engineering*, Vol. 128, Nov. 1, 1929, pages 569–571.

Condensed from paper read before the Iron and Steel Institute, Sept. 12, 1929. *Metals & Alloys*, Vol. 1, Feb. 1930, page 390. LFM(20)

Studies on Zinc and Barium Ferrites. JOSEPH GUILLISSEN & PIERRE J. VAN RYSSSLBERGHE. *American Electrochemical Society, Preprint* 59–1, April 1931 Meeting, 11 pages.

The formation of zinc ferrite by the direct addition of zinc and ferric oxides was studied at various temperatures between 580° and 660° C. During the first 2 or 3 hours of heating, the reaction obeys Tammann's logarithmic law on reactions between solid phases. An apparent equilibrium appears afterwards. At 580° C. the reaction takes place extremely slowly. It is found by thermal analysis that there is no evidence for the formation of a compound containing more zinc oxide than $ZnFe_2O_4$, at least not below 1070° C. The solubility of zinc ferrite in 1N and 2N H_2SO_4 is studied. A mixture of 7.5% SO_2 in air, passed on zinc ferrite heated at 450° C., decomposes it slowly and liberates the zinc as zinc sulphate. The formation of barium ferrite resulting from the heating of a mixture of barium carbonate and ferric oxide was studied at 720° C. It also obeys Tammann's law. The apparent equilibrium towards which the reaction tends is destroyed when the mixture is stirred and heated again at the same temperature: the reaction goes on according to Tammann's law, the velocity of reaction being, however, considerably smaller than originally. The results are discussed and explained on the basis of diffusion. (20)

Small Jobs in the Running of Machinery in Steel Works. (Kleinarbeit im Maschinenbetriebe auf Hüttenwerken.) W. PAULING. *Stahl und Eisen*, Vol. 50, Aug. 14, 1930, pages 1153–1164.

Report 47 of the Committee on Machinery of the Verein deutscher Eisenhüttenleute. Includes discussion. The article points out how stoppages and breakdowns of machinery may be avoided by attention to lubrication and lubricating devices, protection of bearings against dust, use of roller bearings, case hardening of wearing surfaces, etc. GN(20)

The Diffusion of Ions of Salts in Aluminum. (Diffusion d'ions de sels dans l'aluminium.) M. J. CICHOCKI. *Comptes Rendus de L'Académie des Sciences*, Vol. 191, Nov. 10, 1930, pages 841–842.

The author refers to the experiments of Peczalski on the diffusion of salts in metals and to the fact that in penetrating the metals a thermionic current is produced. He describes experiments in this connection, which he has made with aluminum, using a tube of the metal having an internal diameter of 2 mm. and an external diameter of 4 mm. In his experiments $NiCl_2$ was used as the diffusing salt. The experiments with aluminum fell into line with those of Peczalski, except that the thermionic emission was positive. OWE(20)

The Periodic Arrangement of the Chemical Elements in 1930. C. E. FAWSITT (University of Sydney). *Chemical Engineering & Mining Review*, Vol. 23, Jan. 5, 1931, pages 152–153.

An abstract of an address on Nov. 26, 1930, at the annual meeting of the Australian Chemical Institute. The periodic arrangement of the chemical elements is tabulated. In recent years the following elements have been discovered: masurium, illinium, hafnium and rhenium. Hafnium is the only one found in any quantity. It is unlikely that the electronic arrangements as now accepted will be greatly altered in the future. Isotopes are best considered as separate elements. WHB(20)

Diffusion and Distribution in a Solvent of Graded Composition. G. S. HARTLEY. *Transactions of the Faraday Society*, Vol. 27, Part 1, Jan. 1931, pages 10–29.

The author describes experiments designed to determine the distribution of a molecular solute in a solvent having a gradient of some other property, namely a gradient of concentration of a second solute. No evidence was obtained that the distribution of a solute free to move in a maintained gradient of composition is affected by forces other than those internal ones which govern solubility and the dynamic effect of the diffusing components. Diffusion from regions of higher to those of lower diffusion velocity independently of these factors does not apparently occur. The statistical effect examined theoretically by Chapman (*Proceedings Royal Society*, Vol. 119A, 1928, page 34) must, therefore, be included in the solubility theory. Further, the factors leading to increase of diffusion velocity must also tend to decrease solubility. OWE(20)

Theories of the Soret Effect. G. S. HARTLEY. *Transactions Faraday Society*, Vol. 27, Jan. 1931, pages 1–10.

A number of kinetic theories of the Soret effect are reviewed and the error common to all is pointed out. It is shown that it is impossible to formulate a valid theory if use is made of standard thermo-dynamic functions only. Independent support is given to Eastman's theory of effect. OWE(20)

A Note on the Preparation of Silver-Free Copper. BART PARK. *Journal American Chemical Society*, Vol. 52, Aug. 1930, pages 3165–3166.

Commercial copper sulphate was recrystallized 3 times. A spectrogram made from it showed about 0.004% Ag. An acid solution of this salt was electrolyzed slowly, seven fractions obtained by deposit; these were dissolved in nitric acid, converted to the oxide by heating, and the oxide reduced by hydrogen in a silica tube. Electrodes were made from the melted copper and tested. The spectrograms showed no trace of silver line at 3281. MEH(20)

Oxidation Reduction Potentials at Carbon and Tungsten Electrodes. LOUIS B. FLEXNER & E. S. GUZMAN BARRON. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2773–2776.

Graphite and tungsten electrodes have been tested in oxidation–reduction systems. In the quinhydrone system graphite gives results identical with those obtained at blank Pt and Au-plated Pt; whereas W gives entirely different results. In the ferro–ferricyanide system graphite gives measurements 1 to 2 millivolts less than Pt, whereas those with W are 5 to 10 mv. less. In a dyestuff system, well or poorly poised, graphite gives the same results as Pt; W gives reliable values only when the system is well poised. The potentials of graphite and W against a reversible dye system are unaffected by change from a nitrogen to a hydrogen atmosphere. MEH(20)

A Study of Losses in the Transport System of a Drop Forge. (Untersuchung über Förderverluste in einer Gesenkschmiede.) W. SCHÖNING. *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 45–54.

The article deals with the economies to be effected by means of a rational transport system in a drop forge. GN(20)

The Chemist in the Metallurgical Industries. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 435–441.

A description of the processes carried on at the Henry Wiggins and Co. plant at Birmingham, England, where nickel alloys are made. MPB(20)

200,000-KW. Mercury-Vapor Power Plant for Schenectady. *General Electric Review*, Vol. 34, Feb. 1931, page 142.

Construction work has started for the erection of a large mercury-vapor power plant. It will be the first outdoor steam plant, one of the first plants to have coördinated industrial requirements and utility sources of power. Besides the 2000-kw. mercury boiler and turbine the new station will include a steam boiler to supply 300,000 lbs. of steam per hr. from the mercury condenser, for process heating and testing steam in the General Electric Works. A large part of the power generated from the mercury turbine is obtained at very high efficiency. The boiler will require 250,000 lbs. of mercury. WHB(20)

FOUNDRY PRACTICE & APPLIANCES (22)

Status of Foundry Sand Control as Seen by the Sand Producer. W. WORLEY KERLIN. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Aug. 1930, pages 373–384.

The quality of new sand determines to a large extent the venting factor, strength and temper of molding sand. For control, the sand producer must know the chemical analysis, the amount of colloidal bond and the screen analysis of his deposits. CHL(22)

Some Observations on Preparation and Use of Synthetic Sand. L. B. KNIGHT. *American Foundrymen's Association, Preprint* No. 31–8, 1931, 10 pages.

Author emphasized the need for information on the preparation of synthetic sand. To use the material, definite standards of permeability, bond strength and moisture content must be established and maintained. CHL(22)

Molding Practice in the Foundry. (Die Formpraxis in der Metallgiesserei.) E. BECKER. Heft 14 of H. Hermanns' series on Works Practice in the Iron, Steel and Non-Ferrous Foundry. Wilhelm Knapp Verlag, Halle (Saale), 1931. Paper $6^1/_4 \times 9^1/_4$ inches, 112 pages. Price 8.50 RM.

A very elementary treatise, about what one would expect to be used as a test in a manual training course in a grade school. It illustrates such things as slicks and rammers and some simple molding machines. Sweep molding and the lost wax process are given brief mention. The scope of the work may be judged from the 3 pages on the testing of molding sand, which certainly tell very little, and part of that is not very helpful in that it carries the idea that electrical resistance measurements will satisfactorily indicate moisture content.—H. W. Gillett (22)-B-

Progress in Gray Iron Castings. HYMAN BORNSTEIN. *Metal Progress*, Vol. 1, Oct. 1930, pages 43–46.

A discussion of the modern trends in the production of cast iron. Closer carbon control and/or alloy additions of Ni and Cr yield castings of 60,000 lbs./in.^{2} tensile strength. Heat treatment also briefly discussed. WHK(22)

Some Recent Advances in the Field of Foundry Sand Control. A. A. GRUBB. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Dec. 1930, pages 34–46.

Author briefly considers factors which are responsible for foundry sand troubles. CHL(22)

Some Responsibilities of the User in Obtaining the Best Product of the Steel Foundry. R. A. BULL. *Research Group News* (Electric Steel Founders' Research Group), Vol. 7, Jan. 1931, pages 352–362.

Diversity in surface finish; range of physical properties; comparing cast steel with other material; casting design; pattern equipment; advice for the producer, are principal topics covered. MFB(22)

Simple Methods for Improvement and Control of Gray Iron Manufacture. L. F. C. GIRARDET. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Nov. 1930, pages 624–643.

Control operations are divided into 3 classes; (1) mechanical properties; (2) metallographic structure; and (3) chemical analyses. Fremont shear test is advocated as showing properties of the casting. CHL(22)

Value of Analysis and Specification for Core Oils. J. A. GITZEN. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, July 1930, pages 97–106.

If the iodine number is 180 or over, any drying or semi-drying oil, except fish oil, may be used to replace linseed oil in cores. CHL(22)

Deep Etching of Brass Applied to Gating Problems. R. W. PARSONS. *American Foundrymen's Association, Preprint* No. 31–11, 1931, 10 pages.

Defects arising from improper gating of brass castings are revealed by deep etching. Regating of globe-valve castings after investigating causes for leaks by the deep etching method reduced the losses to a minimum. Conclusions regarding metal conditions from etched sections of dissimilar castings cannot be drawn. CHL(22)

Gating Iron Castings. E. M. HANDLEY. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Feb. 1931, pages 29–36.

Gate area, position of gate on casting, and pouring temperature of cast-iron are essential factors that control the soundness of castings. The mathematical expressions derived by Dietert for determining gate area and pouring time are illustrated. CHL(22)

Reducing Materials-Handling Costs in Jobbing Foundries. F. D. CAMPBELL. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Oct. 1930, pages 541–560.

Production and annual earnings are increased by proper planning, arrangement and installation of labor-saving devices in foundries. CHL(22)

Notes on Behavior of Sand Molds in Steel Foundries. PAUL L. GOODALE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Sept. 1930, pages 471–480.

Characteristics and properties of core surfaces when casting steel against them were studied. Oxide of iron penetrates the sand to form some iron silicate. The author has various ideas to overcome slag formation which presents difficulties in obtaining smooth steel castings. CHL(22)

Up-To-Date Methods in the Stove Foundry. JAS. BREAKEY. *Canadian Foundryman*, Vol. 22, Feb. 1931, page 7.

A description of methods used in the manufacture of stoves of various descriptions, as carried out by the McClary Manufacturing Co., London, Ont., a subsidiary of General Steelwares, Ltd. Special attention is given to a stove-top polisher. Article is illustrated by four photographs. OWE(22)

Electric Process Iron for Cylinder and Cylinder-Head Castings. H. E. BROMER. *American Foundrymen's Association, Preprint* No. 31–13, 1931, 15 pages.

Duplexing of cast iron during high-production period proved economical. Strengths of 40,000 lbs./in.^{2} were obtained for gray iron made in this manner while alloyed irons were obtained with strengths of 60,000 lbs./in.^{2} CHL(22)

Core-binders. H. H. EBERT. *Iron & Steel Industry & British Foundryman*, Vol. 3, Sept. 1930, pages 363–364.

A discussion of natural and artificial core-binding materials and their uses are given. CHL(22)

Die Castings for Economy in Production. D. L. COLWELL. *Metal Progress*, Vol. 1, Sept. 1930, pages 91–95.

A review of the materials and methods used in die casting with considerations of their advantages and limitations. WHK(22)

Superheating of Cast Iron. (Ueberhitzung von Gusseisen.) P. BARDENHEUER & K. L. ZEYEN. *Giesserei*, Vol. 16, Aug. 16, 1929, page 733; *Metallurgist*, Sept. 27, 1929, pages 141–142.

See *Metals & Alloys*, Vol. 1, Dec. 1929, page 293. (22)

The Most Potent Variable. GEO. BATTY. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Aug. 1930, pages 309–331.

Deficiences of the molding sand are the cause of most defects in steel castings. The importance of the following factors relating to molding sand are discussed: grain shape and size, surface area covered by binder, bond additions, permeability of facing and backing material, surface moisture and pouring temperature. CHL(22)

A Comparison of Natural Bonded and Synthetic Molding Sands for the Steel Foundry. H. J. COLE. *American Foundrymen's Association, Preprint* No. 31–10, 1931, 9 pages.

A comparison is made of the properties of synthetic and natural bonded steel molding sands as used in actual plant practice. Physical properties of the sands and clays used are given. CHL(22)

Design of the Modern Cupola Calls for Study. *Canadian Foundryman*, Vol. 22, Mar. 1931, pages 7–9.

An article dealing with the design of cupolas, in which tables are given, showing the capacity ratings and overall dimensions of some of the leading standard cupolas of the present day. Methods now adopted in the building of the cupola shell and in the support of the cupola are discussed, and the designs of tapping and slag spouts, wind belts, and tuyères are dealt with. OWE(22)

Continuous Melting from Cold Stock of Gray Iron in Electric Furnace. N. L. TURNER. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Jan. 1931, pages 749–760.

The use of a 3-ton electric furnace operating continuously increased the production per floor and decreased the cost of molding equipment. The charge consisted of cast-iron borings, shop scrap and steel clippings plus alloy additions. The ideal analysis of iron is given as C 3.25 to 3.35%; Si 2.75 to 2.85%; Mn 0.45 to 0.60%; P 0.60 to 0.70%; and S less than 0.09%. CHL(22)

Some Considerations in Gating and Pouring Castings. E. V. RONCERAY. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, May 1930, pages 41–64.

Four conditions under which there will be no piping in castings: (1) when the casting is at constantly uniform temperature; (2) when cooling progresses by parallel layers; (3) when no change in volume occurs; and (4) when metal is fed through heads to prevent shrink cavities. Various methods of gating to produce results approaching one or another of the conditions are taken up. CHL(22)

Factors Which Influence the Surface Quality of Gray Iron Castings. W. G. REICHERT & D. WOOLLEY. *American Foundrymen's Association, Preprint* No. 31–7, 1931, 27 pages.

The quality of the surface of castings as affected by varying conditions of grain fineness, moisture content, mold hardness, sea coal additions, increase in clay content, method of ramming, pouring temperature and fluidity of the metal was determined for sands of various A. F. A. classifications. The main factors that influence surface quality are grain size and moisture content. CHL(22)

Briquetting Cast-Iron Borings for Use in the Cupola. HARRY RAYNER. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Sept. 1930, pages 460–470.

The loss on melting briquettes is about that of cast-iron scrap. As much as 25% of total melt in the form of briquettes is used regularly without difficulty. CHL(22)

Profitable Reclamation of Sand in the Steel Foundries. M. D. PUGH. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Aug. 1930, pages 289–308; Discussion, pages 321–331.

"Burning in" of sand results from lack of uniformity of sand grains, quality of clay and the water present. Sizing tests of many sands are shown by curves. Reclamation and some failures in reclamation of steel molding sands are discussed. CHL(22)

Carbon and Sulphur in the Cupola—Some Properties of Coke. JAMES T. MACKENZIE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Sept. 1930, pages 385–432.

An equilibrium total C content is obtained under given cupola conditions depending on the coke used. A series of tests were carried out using 6 different cokes and various metal charges one variable changing in each heat. Effects of repeated melting were made by repeatedly using the same material. Data on changes in chemical analyses; the Brinell hardness; chill depth; temperature and blast variation; modulus of rupture and modulus of elasticity were tabulated and discussed. CHL(22)

The Founding of High Melting Point Alloys. J. MCNEIL. *Metal Industry*, London, Vol. 35, Nov. 22, 1929, page 489; Nov. 29, 1929, page 522.

Discussion *Foundry Trade Journal*, Vol. 41, Dec. 5, 1929, pages 407–408. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 431. (22)

Effect of Excessive Atmospheric Moisture in Cupola Blast. NEIL A. MOORE. *American Foundrymen's Association, Preprint* 31–2, 1931, 14 pages.

Refrigerating system was installed for controlling moisture in the cupola blast. Author believes that excessive moisture increases the chilling tendencies of cast iron. He also believes that excessive moisture increases the oxygen content of the iron and thereby retards the breaking down of cementite into ferrite and graphite. CHL(22)

Can Steel Founding Become an Exact Science? F. A. MELMOTH. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Mar. 1931, pages 21–35.

Control of materials, the exact predetermined series of molding operations, the control of solidification, and improved ideas on gating and feeding are essential and will come about through application of scientific principles. The industry still suffers from out-of-date thought. CHL(22)

Cupola High-Test and Alloy Irons in a Machine Tool and Gray Iron Jobbing Foundry. L. M. SHERWIN & T. F. KILEY. *American Foundrymen's Association, Preprint* No. 31–4, 1931, 42 pages.

Problems relating to pouring, gating and feeding of high-test iron castings are discussed. Effects of Mo, Ni and Cr in the iron mixtures are described. CHL(22)

Effect of Heat on the Permeability of Natural Molding Sands. WALTER M. SAUNDERS & WALTER M. SAUNDERS, JR. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, July 1930, pages 259–272.

The permeability of different sands have been studied in a simple device for measuring permeability at temperatures up to 1000° C. The effect of steam and expansion of sand grains on permeability is demonstrated. CHL(22)

Carbon Is Controlled in Synthetic Gray Iron. EDWIN BREMER. *Foundry*, Vol. 58, Nov. 15, 1930, pages 51–52.

Describes method used by Robbins & Myers, Inc., Springfield, Ohio for disposing of their sheet scrap. The sheet steel scrap was melted in rocking type electric furnace with addition of ferrosilicon and petroleum coke. Absorption of C by molten metal involves the length of time the 2 are allowed to react and the weight of coke added. C and Si in resulting iron may be varied to meet any desired range. Si usually ranges from 2.0–3.50% and C from 2.5–3.5%. VSP(22)

Aspects of Carbon Control in the Cupola. H. W. KEEBLE. *Metallurgia*, Vol. 3, Feb. 1931, pages 147–148.

The carbon content of the cast metal depends on (1) initial total carbon content of materials charged, (2) general cupola operation, (3) atmosphere at the melting zone, (4) time of contact with the fuel. An example is given which shows that over an extended period the carbon content of the iron was almost independent of the carbon content of the charge. Directions for producing a low C iron are given. Contains 6 references. JLG(22)

FURNACES & FUELS (23)

Furnace Insulation. A. E. HUBBARD. *Industrial Chemist*, Vol. 6, Nov. 1930, pages 465–466.
The importance of proper insulation for metallurgical and other furnaces is pointed out and the characteristics of suitable insulation materials are discussed. MPB(23)

Fuel Oil for Pot Annealing of Wire. R. S. COULTER. *Wire & Wire Products*, Vol. 5, June 1930, pages 215–217.
Description of furnaces, oil system, burners and other equipment for pot annealing of wire. Operating results are given and economics discussed. GN(23)

Artificial Atmospheres for Electric Furnaces. A. N. OTIS (General Elec. Co.). *Iron Age*, Vol. 126, Sept. 25, 1930, pages 844–848.
The H content of the atmosphere prevents oxidation of the product and the small methane content prevents decarburization. Tests showed that coils of 0.55% C wire heated to 1300° F. and held for 8 hrs. showed no scale or decarburization under the microscope. Electric furnaces equipped with electrolene may be used for annealing sheets, bars, wire and similar products. Furnaces may be designed to meet a variety of conditions, with a minimum of heating time and floor space. Advantages to be gained by the use of gases in industrial operations are manifested. VSP(23)

The Utilization of Waste Heat in the Steel Industry. CHARLES W. E. CLARKE. *Yearbook American Iron & Steel Institute*, 1930, pages 94–120.
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 855. (23)

Electric Furnaces for Heat Treatment. (Sur les fours electriques de traitment thermique.) JEAN DESMURS. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Aug. 1930, pages 354–359.
Advantages, description and future of electric furnaces for heat treatment are discussed. For temperatures up to 1000° C. the elements in the resistance furnace are made of non-oxidizing Ni-Cr alloys. The manufacturers guarantee this alloy for 3000 hours at 950° and of indefinite service at 800° C. For higher temperatures than 1000° C. the elements consist of graphite or compounds of carborundum. GTM(23)

Developments in Melting and Annealing Non-Ferrous Metals. ROBERT M. KEENEY. *Fuels & Furnaces*, Vol. 8, March 1930, pages 331–333.
Abstract of a paper read before the American Institute of Mining & Metallurgical Engineers, Feb. 17–21, 1930. See *Metals & Alloys*, Vol. 1, May 1930, page 526. MS(23)

Practical Points on Furnace Design. JOHN C. KIELMAN. *Metal Progress*, Vol. 1, Sept. 1930, pages 58–63.
A general discussion of the design and materials entering into the construction of furnaces, particularly of the fuel fired type, for diversified metallurgical applications, such as forging, hardening, annealing and carburizing. WHK(23)

High Frequency Furnace in Steel Making. (Le four á induction á haute frequence en acierie.) M. GUTMANN. *Aciers Speciaux, Métaux et Alliages*, Vol. 3, Special No., 1928, pages 518–526.
Principles and technical description of installations. Qualities of high frequency. Actual application of high frequency furnace. The metallurgy of high frequency furnace is discussed emphasizing the advantages in using this furnace for making quality steel. GTM(23)

Furnaces for Annealing, Galvanizing and Japanning of Strip Steel. J. B. NEALEY. *Wire & Wire Products*, Vol. 6, Feb. 1931, pages 47–49, 75–78.
Illustrated description of continuous furnaces with automatic control for annealing, galvanizing and japanning of strip steel. GN(23)

Electric Furnaces and Low-Temperature Treatments. J. E. ORAM. *Metallurgia*, Vol. 3, Jan. 1931, pages 94–96.
Electrically heated furnaces equipped with a fan for air circulation are ideal for tempering, nitriding and heating non-ferrous alloys. JLG(23)

Industrial Electric Heating for Railway Shops. W. S. SCOTT. *Railway Mechanical Engineer*, Vol. 105, Feb. 1931, pages 59–62, 65.
A study of electrical heating equipment in use in the Norfolk & Western shops at Roanoke, Va., with costs of operation and savings effected by its use. Description of the tool heat-treating department, carburizing furnaces and annealing steel castings. GN(23)

The Calculation of Heat Accumulators. (Die Berechnung der Wärmespeicher.) K. RUMMEL. *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 367–374.
Report 147 of the Heat Committee of the Verein deutscher Eisenhüttenleute. The method of calculation of heat accumulators is developed and considered in detail for the checkers of an open hearth furnace. GN(23)

Electric Furnace Cut Insurance Cost 38 Per Cent. *Electrical World*, Vol. 97, Mar. 28, 1931, page 641.
The Enamel Products Co., Cleveland, Ohio, derived this benefit from the installation of electric furnaces in place of fuel-fired equipment. Continuous types of furnace are used for baking enamel on sheet steel (table tops, tub tops, etc.). WHB(23)

Induction Furnaces for Nonferrous and Iron Foundries. MANUEL TAMA. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Sept. 1930, pages 433–440.
The 3 types of induction furnaces are described. An important development is the use of the induction furnace in conjunction with the cupola to superheat cast iron. CHL(23)

Use of Coal Gas in the Heat Treatment of Metals. (Considerations sur l'emploi du gaz de houille dans les traitments thermiques des metaux.) CH. TIXIER. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Aug. 1930, pages 348–353.
Discussion of economical and technical importance in using coal gas for heat treatment in small furnaces. GTM(23)

Electric Recuperative Furnaces at Citroen Plant. (Les fours electriques a recuperation aux usines Citroen.) *Journal du Four Electrique*, Vol. 40, Jan. 1931, pages 11–13.
Citroen company recently installed 2 continuous counter-current heating furnaces for carburizing work. Structural features and expense sheet are given for old and new installations. JDG(23)

Some Notes on the Use of Gas in Industrial Furnaces. F. A. MCLEAN. *Iron & Steel of Canada*, Vol. 14, Feb. 1931, pages 25–26.
The author discusses the use of burners for the combustion of illuminating gas in industrial furnace operation and particularly the latest type of high-pressure air system developed by New Jersey Meter Co., of Plainfield, N. J. The induction blower used in this system is given special attention, and details are quoted of the various sizes of blower available. OWE(23)

Gas Furnaces for Carburizing. W. F. CHUBB. *Automobile Engineer*, Vol. 19, Dec. 1929, pages 496–497.
Notes on installation of the Moss Gear Co., Ltd. Furnaces for carburizing cam shafts, gears and other automobile parts. Charging machine slots provide outlets for gases. Other changes are noted. Comparative costs are only slightly in favor of the gas furnaces over the electric furnaces. RHP(23)

Electrothermics. (Elektrothermie.) M. PIRANI. Julius Springer Verlag, Berlin, 1930. Cloth, 6 × 9¼ inches, 293 pages, 268 figs. Price 36 RM.
The sub-title of this book is "The Electrical Production and Technical Use of High Temperatures." It deals primarily with types of electric furnaces, rather than with the chemistry or technology of their use. For instance, one will get an idea of the various kinds of electric furnaces used in steel melting, but very little about the ways in which the actual operation of such a furnace resembles or differs from that of an open-hearth.
Obsolete furnace types and descriptions of furnaces that never existed save on paper in patent specifications are less in evidence in this book than in some older German books on the subject, though the section on fused quartz is largely taken from patent literature, and that on gases features the Pauling furnace for nitrogen fixation to a degree that seems scarcely justified by its present degree of technical importance. In some of the sections, the comments on American use of various types of furnaces are not necessarily very accurate.
On the whole, the book is instructive and pretty well up to date on what it covers. It is well printed and illustrated, but has no index, only a one-page table of contents. References to other literature are almost lacking.
Besides the sections by Pirani himself, others are written by R. Gross, M. Tama, R. Schneidler, F. Singer, H. Pauling and G. Keinath.
The usual subjects in a text-book of this nature are included, viz., furnaces for steel melting, iron ore smelting, ferro alloys, carbide (very brief treatment of the last three), non-ferrous melting, silicon carbide, fused alumina and electrically melted cement, graphite, quartz and nitric acid. Electrothermic research methods (chiefly a description of laboratory furnaces) and electrical measurements are also described, these last two sections occupying a third of the book. Furnaces of the types used in heat-treatment of steel and similar uses are not treated in this volume.—H. W. Gillett (23)-B-

The Present State of Carbonization at Low Temperatures and Preparation of Artificial Anthracite. (Etat present de la technique de la carbonization a basse temperature et de la preparation d'anthracites artificiels.) CH. BERTHELOT. *Revue de Metallurgie*, Vol. 27, Dec. 1930, pages 672–679.
England leads in low temperature carbonization by making about 11,000 tons daily. France is beginning to install units as large as 250 tons per day and the industry seems to have a promising future. Artificial anthracite is made at Mines de Noeux by treating a mixture of coke and tar with steam superheated to 650°. The greatest obstacle of the industry is the smallness of the individual units running the overhead too high. The requirements for successive operation and the cost both of installations and successful operation for different capacities are given. JDG(23)

Use of Washed Furnace Gas Promotes Economy. W. A. HAVEN & C. B. THORNE (Arthur G. McKee & Co.). *Steel*, Vol. 87, Dec. 4, 1930, pages 54, 56, 59.
Paper read before Iron and Steel Division of the American Society of Mechanical Engineers. MS(23)

Calculations for an Electrical Resistor Furnace. (Note sul calcolo dei forni elettrici a resistanza.) R. LEVI. *La Metallurgia Italiana*, Vol. 9, April 1931, pages 292–302.
Discussion of the theory of calculations for design of resistor furnaces, with an example of its application to an actual furnace. HWG(23)

Average Life of Electric Furnace Roofs. S. KRIZ & H. KRAL. *Iron Age*, Vol. 126, Dec. 11, 1930, page 1775.
Abstract translation of article in *Stahl und Eisen*. Gives data on the influence of the age of an electric furnace on the length of the heat and energy consumption. VSP(23)

Galvanizing Furnace Using Both Direct and Indirect Heating. HARRY E. GILBERT. *Iron Age*, Vol. 126, Sept. 18, 1930, pages 771, 828.
Describes furnace designed for heating galvanizing kettle which uses radiation, convection and conduction methods of heat transfer. Silicon carbide bricks are used for protecting and heat storage walls. Adapted to the use of either gas, oil or electricity. Operating cost is very low. Accumulation of dross in %, based on spelter charged, is likewise very small. VSP(23)

2000-Kw. 75-Ton Furnace Anneals Large Castings. A. G. HOTCHKISS. *Electrical World*, Vol. 38, Apr. 25, 1931, page 768.
At the Schenectady Works of the General Electric Co. a 2000-kw. car-bottom type electric annealing furnace with a maximum loading capacity of 75 tons has been installed. The loading space of the car is 27 ft. × 17 ft. × 12 ft. The furnace roof is of flat arch construction and the walls are of standard furnace construction. The heating units are of Ni-Cr ribbon resistor type and are located on all walls and ceiling of the furnace and bulkhead and floor of the car. Floor units are protected by cast-alloy hearth plates. The heating units are divided into eight zones or sections each separately controlled. The use of a light weight refractory has considerably shortened the heating and cooling cycles. The openings in the roof are opened and closed from the operator's booth by a chain and sprocket connection. WHB(23)

Mixed Gases Promote Economy in Steel Making. WILLIAM C. BUELL, JR. *Steel*, Vol. 87, Aug. 7, 1930, pages 54, 57, 60; Aug. 21, 1930, pages 50, 52, 54, 56.
Blast-furnace gas has no use outside of the steel plant other than its flow as electrical energy into the network of the public service system. In the plant, it has been used largely under the boilers, and in the heating stoves. Coke-oven gas, however finds a ready market. By mixing blast-furnace gas with coke-oven gas for use in open hearth furnaces, reheating-furnaces, soaking-pits, etc., a large portion of the coke-oven gas would be released for profitable sale. Presents tables and charts showing the effect of varying the volume ratio of the two gases on the calorific intensity of the resulting mixed gas and the thermal capacity characteristics of the gases. MS(23)

High-Frequency Furnace as New Means of Production in Steel Works. (Hochfrequenzofen als neues Stahlwerks—Produktionsmittel.) N. BROGLIO. *AEG Mitteilungen*, Vol. 4, Feb. 1931, pages 37–42.
The furnace is of the coreless type; it is built by bringing the material of the crucible (furnace) in dry powder form between a metallic cylinder and the heat insulation of the coil; the powder is tamped tightly after filling and then sintered together by slowly heating it inductively so that finally a dense crucible or container results, into which the batch is placed. The furnace is heated by a single phase current of 150 amp. at 1200 volts and 2000 cycles from a special motor-generator set. To compensate the very low power factor of such circuit, a battery of condensers is connected in parallel to the furnace circuit; according to the load conditions, more or less of these condensers are automatically connected, which keeps the power factor almost constant at unity. From tests, the consumption, including efficiency of MG-set and transformer, was found to be about 720 Kwh./ton when charged with cold batch; time required for melting was about 85 min., in average, from start to pouring for a charge of 300 kg. The average efficiency of the electrical plant was found to be about 72%. A detailed description of the installation and working conditions is given. Ha(23)

Bake Cylinder Block Cores in Continuous-Ovens. E. W. BEACH (Campbell, Wyant & Canon Foundry Co.). *Foundry*, Vol. 58, Dec. 15, 1930, pages 56–59.
Abstract of article in "Industrial Oven Notes". Describes the construction of ovens of the Campbell, Wyant & Canon Foundry Co., Muskegon, Mich. Two types of ovens are used, namely, horizontal and vertical. VSP(23)

REFRACTORIES & FURNACE MATERIALS (24)

Special Refractories for Metallurgical Research. DONALD TURNER. *Transactions Faraday Society*, Vol. 27, Mar. 1931, pages 112–124.

A description of refractory materials and technique of their use as practised at the National Physical Laboratory. Alumina, thoria, magnesia, lime, chromite and clay mixtures are used. Thermocouple tubes are extruded using a cellulose acetate solution with the powdered materials. PRK(24)

High-Silica Retorts at the Rose Lake Smelter. G. L. SPENCER, JR. (American Zinc, Lead & Smelting Co.). *Technical Publication* No. 378, *American Institute Mining & Metallurgical Engineers*, 1931, 6 pages.

Silica flour is added to the fireclay-grog mixture to produce a retort of high strength, which enables the use of a longer retort without danger of sagging. The analysis of 1 retort mixture in % was: 5.59 ignition loss, 66.06 SiO_2, 24.22 Al_2O_3, 2.96 Fe_2O_3, 0.56 CaO and 0.52 MgO. JLG(24)

Refractory Materials for Electric Furnaces. I. The Melting of Lead and Its Alloys. ALFRED B. SEARLE. *Metal Industry*, London, Vol. 38, Jan. 2, 1931, pages 3–4.

The maximum temperature attained in an electric furnace when melting Pb or Pb alloys is about 1000° and generally much lower. Electric furnaces consisting essentially of a crucible or single-piece lining, a heating element and a casing are the most suitable for melting this class of alloys. The properties of various refractory bricks are outlined and the suitability of magnesia brick for parts of a Pb furnace in contact with slag. For most induction furnaces dead-burned magnesia is best with pitch or colloidal magnesia as binding agent. A melted mixture of lead oxide and clay applied as a paste affords a means of overcoming the difficulty of using high-frequency furnaces for these fusible alloys. Silica bricks are used in the roofs. Most refractory materials are good conductors of electricity at red heat, which often results in serious leakage of current and may cause a serious defect in the furnace. WHB(24)

Highly Refractory Building Materials for the Metal Industry. (Hochfeuerfeste Baustoffe für die Metallindustrie.) W. STEGER. *Metallwirtschaft*, Vol. 9, June 20, 1930, pages 528–532.

Fireclay, silica and magnesite are the most commonly used refractories, but are not suitable for very high temperatures. Bauxite and diaspor, containing 45–80% Al_2O_3, have been used somewhat in basic open hearths and Pb smelting furnaces. Their melting point is SK 36–38 and they do not have very good strength at high temperatures. Mullite, 3 Al_2O_3.2 SiO_2, containing 72% Al_2O_3 and 28% SiO_2 is the only chemical compound of Al_2O_3 and SiO_2. Sillimanite, Al_2O_3.SiO_2, forms mullite and excess SiO_2 when burned. These materials have become very important refractories recently. Both the natural and synthetic products are used. A synthetic mullite made by fusing the materials in an electric furnace, pouring into molds and slowly cooling, similar to glass annealing, gives excellent results. High cost is a disadvantage and further investigation is necessary. Artificial corundum, made by fusing bauxite, with a proper binder, is an excellent refractory, but on account of high cost has been limited mostly to laboratory use. Chromite is burned at a high temperature and slowly cooled. It withstands very high temperatures and the action of slags, but is sensitive to sudden changes in temperature. It is especially useful on account of its chemical resistance and is used as a separating layer between magnesite and silica bricks in basic open hearth furnaces. Chromite is frequently used as a patching material. 10–20% added to fireclay and diaspor improve these very much. Silicon carbide is used without a binder or with clay as a binder. It has a very high heat conductivity and resists sudden temperature changes very well, but is attacked by ashes and slags containing Fe, S and Ca. It cannot be used in oxidizing atmospheres. It is used mostly in steam generating plants and for muffle furnaces, also as a patch. Zirconium oxide resists chemical attack, but is too expensive for industrial use. CEM(24)

The Slagging of Fire-Clay Bricks as Dependent on Flux Contents and Porosity. (Ueber die Abhängigkeit der Verschlackung von Schamottesteinen vom Flussmittelgehalt und der Porosität.) OTTO HEBESTREIT. Doctor's Thesis, Technical University, Aachen, 8 pages.

This investigation deals with those properties of fire bricks which influence the formation of slag and can be tested exactly, namely, chemical composition and porosity. The testing methods are described; the results are, briefly, the following: bricks of one part Al_2O_3 and 2 parts SiO_2, pure and containing fluxes, were made to form a slag with simply composed materials; no difference could be found in the behavior. The slagging is most pronounced with the oxides TiO_2, Fe_2O_3 and CaO; very little with Na_2O. The slagging is not proportional to the porosity except for absolutely identical bricks which differ only in porosity. The structure of the brick determines the formation of slag, especially the nature of the pores and their connections. Ha(24)

Some of the Newer Uses for Silicon Carbide. CHARLES MCMULLEN. *American Electrochemical Society, Preprint* 59–21, April 1931 meeting, 6 pages.

Important recent adaptations of silicon carbide are recorded and discussed. In recuperators cylindrical tubes are used. In the "Carboradiant" combustion chamber a mixture of air and fuel is injected into a silicon carbide box. The Thornhill-Anderson furnace has an arched overhead combustion chamber made of silicon carbide. Other applications include boiler furnace walls, heating elements, therapeutic lamps, resistors for radio equipment and lightning arresters. A tabulation of the physical properties of silicon carbide is appended. (24)

GASES IN METALS (25)

Removal of Gases from Aluminum Alloys. W. CLAUS. *Metallurgist*, Dec. 27, 1929, pages 190–191.

The methods for removing dissolved gases from molten Al alloys are described and the results given of experiments showing the effect of method developed by the author and Kalähne applied to Y-alloys and to 8% Cu alloy. Review of a paper in *Zeitschrift für Metallkunde*, Aug. 1929. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 389. (25)

The Combination of Alkali Metals with Nitrogen under the Influence of Electrical Discharges. (Ueber die Vereinigung von Alkalimetallen und Stickstoff unter dem Einflusse elektrischer Entladungen.) WILHELM MOLDENHAUER & H. MÖTTIG. *Berichte der deutschen Chemischen Gesellschaft*, Vol. 62B, Sept. 18, 1929, pages 1954–1959.

Contains 8 references. Alkali metals were introduced into a glass tube which was filled with N_2 gas to 25 mm. pressure and into which 2 Pt electrodes, about 7 cm. apart, had been fused. An electric current was discharged across the electrodes and when the pressure of N_2 fell to 1 mm. more N_2 was pumped in. This procedure was continued for many hours. Cs, Rb, K and Na form azides and Cs, Rb and K also form nitrides, which are formed by decomposition of the azides. Na does not form a nitride under these conditions and it has not been proved that a nitride exists. Li does not form an azide with N_2, but forms a small amount of nitride. CEM(25)

Nitrogen Segregation in Steel. (Stickstoffseigerung im Stahl.) H. DIERGARTEN & W. EILENDER. *Stahl und Eisen*, Vol. 51, Feb. 19, 1931, pages 231–232.

A brief survey of experiments of the above authors on segregations of nitrogen is given. The samples were taken from a low carbon basic open hearth ingot. The nitrogen contents in the center of the top and upper part of the ingot were found to be as much as 100% higher than in the outer parts of the ingot. The different behavior of steel of one melt may be due to the above segregations of nitrogen which are known to affect the properties. GN(25)

The Solubility of Oxygen in Solid Iron. (Ueber die Löslichkeit des Sauerstoffs im festen Eisen.) J. KEMPENS (Doktor-Ingenieur dissertation, Tech. Hochschule, Aachen), Feb. 1930, 30 pages.

The reaction $FeO + H_2 \rightleftarrows Fe + H_2O$ was studied from both directions. Heating iron in H_2O vapor $-H_2$ mixtures indicated that at 715° C., 0.11 ± 0.015% of oxygen was soluble in the iron, and at 800° C. 0.095 ± 0.010%. By heating Fe_2O_3 in a $H_2O - H_2$ mixture (28% H_2O), the oxide was reduced to an oxygen content of 0.146% at 715° C., and in a mixture with 32.5% H_2O, to one of 0.156% oxygen at 800° C. The methods of determination are described in detail. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 17. HWG(25)

Nitrogen in Technical Iron. Part IV. The Effect of Cold Work and Precipitation of Nitrogen on the Magnetic Properties of Technical Iron. (Zur Frage des Stickstoffs im technischen Eisen. IV. Das Zusammenwirken von Kaltverformung und Stickstoffausscheidung auf die magnetischen Eigenschaften des technischen Eisens.) W. KOESTER. *Archiv für Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 289–294; *Stahl und Eisen*, Vol. 51, Jan. 8, 1931, pages 37–38.

Report 167 of Materials Committee of the Verein deutscher Eisenhüttenleute. This investigation was carried on to determine in what manner the type of the segregation of nitrogen after various heat treatments affects the magnetic properties of cold worked steel, as well as to determine whether or not the sequence of these heat treatments has an effect. In the first group of tests, test bars of Thomas steel, suitable for the Koepsel magnetic testing apparatus, were stretched by 5% to 20% in a tensile testing machine and aged for 2 weeks at 100° C. In the second group of tests, the bars were first aged and then deformed. Aging causes a complete segregation of the nitrogen leading to a considerable increase of the coercive force. After these measurements had been made, the bars were gradually heated to study the effect of the renewed dissolving of the nitrogen, which is completed at 300° C. The coercive force increases with the degree of deformation in case the steel is present in annealed and slowly cooled state. Aging at 100° C. results in a further increase. This further increase decreases, however, with increasing deformation. The same results are obtained when the steel has first been aged and subsequently subjected to the deformation, i. e., the same dependence of the coercive force upon the degree of deformation is observed at the end of the deformation and heat treatment regardless of the sequence of the procedure. It is concluded that the specific effect of the precipitation of nitrogen upon the coercive force decreases with increasing degree of deformation. The particle size and the distribution of the segregated nitrogen has no bearing whatever on the coercive force, which is in agreement with the observation that the amount of precipitated nitrogen is independent of the degree of deformation. The hardness of the steel increases whether the nitrogen is in solid solution or precipitated. Finally, the importance of the above results for the investigation of the causes of mechanical aging is discussed. Maurer's observation is corroborated, that mechanical aging in carbon steels does not affect the magnetic behavior. The magnetic occurrences in the above Thomas steel between 100° and 300° C. are only due to nitrogen. GN(25)

Gases in Metals. C. J. SMITHELLS. *Metal Industry*, London, Vol. 38, Mar. 6, 1931, pages 261–264, 268.

Text of paper London Section of Institute of Metals, March 4, 1931. The solubility of gases in molten metals usually becomes greater at higher temperatures, and is generally much less in solid than in liquid metals. With H_2, Ni, Pb, Fe, Co, Cu and Pd form alloy systems, alkaline earths and alkali metals form hydrides, and Au, Ag, Be and Mg show practically no absorption. Comparatively few metals absorb nitrogen as a gas. The total volume of gas that can be abstracted from brass, Cu, Al or duralumin is of the same order as the volume of the metal, but Ni sometimes contains 100 times its own volume of gas. Removal of gases from metals involves melting in vacuum, or in the case of Al alloys slow pre-solidification with or without bubbling dry nitrogen or chlorine gas through metal, followed by rapid remelting to pouring temperatures. PRK(25)

Gas Removal and Grain Refinement in Aluminium Alloys. W. ROSENHAIN, J. D. GROGAN & T. H. SCHOFIELD. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 305–330.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. (25)

INSPECTION (26)

Rapid Estimation of the Nitrided Case. *Metal Progress*, Vol. 1, Sept. 1930, pages 46–47.

The Monotron, the Rockwell and the Brinell tests, if properly applied, have been found useful in checking the characteristics of the nitrided case by A. B. Kinzel and John J. Egan of the Union Carbide and Carbon Research Laboratories. J. Vilella, of the same laboratories has developed an etchant which gives a line of demarcation at the depth corresponding to an appreciable hardness change. The etchant is made as follows:

Dissolve in 100 ml. of water, 1.25 g. of $CuSO_4$, 2.5 g. of $CuCl_2$, 10 g. of $MgCl_2$, 2.0 ml. of conc. HCl, and dilute to 1000 ml. with 95% alcohol. WHK(26)

Use of X-Rays in the Aeronautical Industry. J. T. NORTON. *Aviation*, Vol. 28, June 28, 1930, pages 1261–1263.

Although the builders of aircraft have not employed X-ray methods to any extent, Professor Norton feels confident that they have a field of application in the materials and parts of which aircraft are made. Certain defects, such as blowholes in castings, inclusion of foreign materials, shrinkage and cracks are readily discovered by X-rays. The X-ray is also found to be extremely valuable in detecting flaws in welds and forgings. The use of this method of inspection has been retarded by the cost and the lack of portability of the equipment. The author asks that the cost be regarded in the light of insurance against failure. In view of the present experiments upon portable equipment, he sees a great future for radiography. (26)

Welding Inspection. R. KRAUS (Westinghouse Elec. & Mfg. Co.). *Preprint, American Society for Testing Materials*, Mar. 1931, 11 pages; *Electric Journal*, Vol. 28, Apr. 1931, pages 219–222.

Deals with visual inspection of welds. There are certain best methods of laying-on the metal for various types of welds. Watching the welders will show whether they are operating correctly. Fillet welds can be gaged for shape and size. Kerosine, immersion, soap and bubble and hot oil tests are briefly mentioned. Kraus states that it is still too early to decide whether non-destructive laboratory test methods such as X-rays, magnetic methods and stethoscopic examination, designed to eliminate the personal factor of visual inspection will find use in daily production. HWG + WHB(26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Chromium in Cast Iron Mixtures. T. F. JENNINGS. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Feb. 1931, pages 801–809.

For general purposes, the Cr content of cast iron should be under 1.0%. Cr increases the hardness, strength and wear resisting properties, does not affect shrinkage materially and lowers the fluidity of cast iron. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. CHL(27)

The Effect of Certain Elements Upon the Segregation of Cementite and its Relation to the Modification Process. J. H. ANDREW. *Royal Technical College Metallurgical Club Journal*, Glasgow, No 7, 1929–1930, pages 16–17.

Speculation upon the relation between the effect of 0.25% Mo in a 3% Ni steel, or of 0.60% Mn in a 0.22% C steel, in which the Mo or Mn is said to hinder free movement of carbides, preventing them from coalescing, and thus producing a fine sorbite, and that of Na in the modification of Al-Si alloys. HWG(27)

Nickel-Vanadium and Nickel-Molybdenum Cast Irons. (Étude sur les fontes au nickel-vanadium et au nickel-molybdene.) JEAN CHALLONSONNET. Second part. *Revue de Metallurgie*, Vol. 27, Dec. 1930, pages 654–671, 37 tables.

Experiments were conducted on 2 series of synthetic irons, free from the usual impurities and those containing Si and Mn in commercial amounts. To these Ni was added up to 2% and Mo up to 0.50% varying the Ni:Mo ratio from 1.6 to 8.75. In case of pure irons Mo addition has no influence on dilation point of cementite, raises Ac point to 725° from 660° and 665° respectively for 1 and 2% of Ni and opposes the graphitizing effect of Ni. No constituents of quenched character were found, though pearlite has a sorbite appearance. Mo pronouncedly increases thermal electromotive force of these alloys. In the second group (3.5 C, 1.3 Si, 0.40 Mn; 3.7 C, 2.5 Si, 0.50 Mn and 2.5 C, 2.5 Si, 0.50 Mn) Mo addition increased the hardness of irons without changing the amount of free cementite with exception of 2.5 C alloy. In gray irons Mo tends to nodulize the graphite, in Ni alloys it increases the dimensions of flakes but has no influence on the uniformity of their distribution. The effects of Ni and Mo combine in refining the structure of iron. In opposition to Si free alloys Ni here eliminates the whitening effect of Mo entirely, probably uniting its action with that of Si. Casting of the alloys into stepped molds showed that Mo does not increase their hardness by forming carbides and does not prevent the graphitizing effect of Ni though introducing a chilling effect with lower C content. The resistance to shearing is increased by its addition from 30 to 50%. JDG(27)

Effect of Nickel and Silicon on the Properties of Whiteheart Malleable Cast Iron (with Special Reference to "Thin-walled Malleable"). Part I. S. J. E. DANGERFIELD, F. JOHNSON & E. R. TAYLOR. *Carnegie Scholarship Memoirs, Iron & Steel Institute*, Vol. 19, 1930, pages 1–18.

10 references. Introduction covers briefly the history and properties of malleable iron. Back of published data on thin-walled malleable and lack of standard test bars of sizes applicable to such castings call for this study. Eight casts were made of the same base composition with varying Ni added, 0.0% to 3.6%. The high C content (3.35% total C) occurring in the base metal was not favorable to good properties as too long an anneal is required and graphitization is promoted. Graphitic C in annealed castings decreases with increased Ni but combined C is unaffected or slightly increased. Nineteen micrographs show the structures observed. Ni increases the fluidity, the tensile strength up to 2.5% Ni from which point it falls off rapidly, Ni does not impair the machining properties, and decreases the size of the temper C nodules up to 2.8% Ni. WLC(27)

On the Effect of Nickel and Manganese on the Properties of High Speed Steel. (Ueber den Einfluss von Nickel und Mangan auf die Eigenschaften von Schnelldrehstahl.) V. EHMCKE. *Krupp'sche Monatshefte*, Vol. 11, Dec. 1930, pages 295–315.

The article corresponds to the publication in *Archiv für Eisenhüttenwesen*, Vol. 4, July 1930, pages 23–35; abstracted in *Metals & Alloys*, Vol. 2, Jan. 1931, page 18. GN(27)

Studies on the Influence of Oxygen and Sulphur on Forging Qualities, Red Shortness and other Properties of Pure Iron. (Untersuchungen über den Einfluss von Sauerstoff und Schwefel auf die Schmiedbarkeit, Rotbrüchkeit und andere Eigenschaften des reinen Eisens.) ERIC W. FELL. *Disertation*, Düsseldorf, 1931 (Verlag Stahleisen m. b. h.). *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 393–400.

Thirty alloys were prepared with changing O and S contents. These were in 2 batches: the first with electrolytic iron as a base melted in a vacuum induction furnace, and the second with Armco iron as a base melted in an oil-fired furnace. These alloys contained up to 1.5% S and 0.144% O. Their forgeability was determined by an experienced smith, hammering out each ingot with a steam hammer into a small slab. The vacuum melted ingots forged better and at lower temperature than those melted in the oil-fired furnace. With 0.03% and more S and low O (0.023%) the ingots were brittle. With higher O content, over 0.05% O, and S contents of 0.01 to 0.02% the ingots were again brittle. The pure O melts (the iron melted in an atmosphere of O) all forged well. Some ingots, unforgeable at low temperatures, forged well at higher temperatures. All melts made from Armco iron were red short and as the S and O were deliberately increased became more so. Notch-impact values at temperatures up to 1080° C. were taken on the 30 samples. Vacuum-melted electrolytic Fe (0.03% O, 0.01 to 0.02% S) showed best toughness: 15.4 mkg./cm.^{2} at room temperature and 5.10 mkg./cm.^{2} at 1080°. Pieces with higher O contents showed very low impact values. All ingots melted in oil-fired furnace gave low impact values at high temperatures. The author gives Brinell hardness figures, discusses effect of O and S upon grain-size and depth of concentration. The effect of O upon red shortness appears to be one of lowering the safe S limit. RFM+GN(27)

Alloys in Steel Castings. F. A. MELMOTH. *Metallurgia*, Vol. 1, Dec. 1929, pages 73–74.

Increased severity of working conditions warrants the production of better steel castings. Such castings can be best produced by the addition of alloying elements such as Ni, Cr or Mo separately or in varied combinations. A table of values of tensile properties of plain and alloy castings indicate the superior properties of alloy castings. JLG(27)

Improvement in Saw Steels Attributed to Alloys. HENRY B. ALLEN (Henry Disston & Sons). *Steel*, Vol. 87, Nov. 6, 1930, page 54.

Abstract of paper read before Wood Industries Division of the American Society of Mechanical Engineers. After heat treatment, steel for the blade should have high elastic limit, good ductility, resistance to impact, resistance to fatigue cracking and uniformity. Ni, in proportions of 1.25%–3.5%, was first element added to plain C tool steel to improve quality. Several objections to this steel were its tendency toward a striated, crystalline structure and sluggishness in tempering. Cr was then tried and found to give high elastic limits, but at some sacrifice in ductility. The steel showed a tendency to check when considerably cold swaged. Cr, however, enhanced hardening power of Ni steels. Steel containing small amounts of Ni and Mo has particularly good ductility and toughness with high elastic limit. Best steel melting practice must be followed. MS(27)

The Advantages of Titanium Additions to Aluminum. (Ueber die Vorteile von Titanzusätzen zu Aluminium.) H. RÖHRIG. *Metallwirtschaft*, Vol. 10, Feb. 6, 1931, pages 105–111, 5 references.

It is difficult to alloy Ti with Al on account of the high melting point of Ti. The best method is to add TiO_2 to the Al ore and reduce the 2 together electrolytically. Ti added to Al in small amounts forms either $TiAl_4$ or $TiAl_3$, a brittle compound. Pure Al has a very coarse grained structure. By alloying with small amounts of Ti, 0.01% to 0.03%, the grain size is reduced considerably. This is illustrated by macrographs. Sheet Al, 1 mm. thick, containing from 0.01–0.19% Ti, was annealed at 500° C., stretched cold 2%, 5% and 10% and then annealed at 600°. The samples were etched in HCl-HF to show the recrystallization structure. With the higher Ti contents the grain size was smaller, but the difference was less noticeable with the 10% cold worked samples. With Ti free Al, recrystallization begins at 300°, with 0.19% Ti at 350°. The influence of these small quantities of Ti on the tensile strength and ductility is slight. The tensile strength of the samples containing Ti which were hard rolled, and those which were annealed at 350° C., was slightly higher and the ductility lower. For those annealed at 450° and 500° the reverse was the case. Corrosion tests were made by immersing samples for 1 hr. at 20° in 4 parts HNO_3, 4 parts H_2O and 1 part HCl. The loss in weight increased in the following order: Annealed at 500° (least), annealed at 450°, at 400°, at 350°, hard rolled (most). Samples containing Ti lost less weight than those without Ti. Those which were annealed during the hard rolling process lost more weight than those not annealed. CEM(27)

The Influence of Nickel and Nickel Chromium on the Properties of Malleable Iron. (Etude de l'influence du nickel et du nickel-chrome sur les proprietes de la fonte malleable.) LEON THIERY. *Revue de Metallurgie*, Vol. 28, Jan. 1931, pages 1–18; Feb. 1931, pages 61–77.

White irons prepared to contain 3% C, 0.4 Si, 0.10–0.20 Mn and 0.018–0.09 S were alloyed with 0.5, 1.4 and 2.5 Ni. They were tested together with the original base and an alloy produced by alloying it with 1.37 Ni and 0.34 Cr. Specimens were cast in sand but removed from it rapidly enough to produce chill. On plain carbon stock the dilation curves show the effect of quenching. The decomposition of cementite begins in them at 1100°. On repeated heating the cementite begins to decompose at A_c. The precipitation of graphite on the first heating can be seen under the microscope. With 0.5 Ni the dilation curves have the same appearance, at least on the first heating, but the cementite begins to decompose here at A_c. The presence of 1.4 Ni lowers by 100° the temperature of graphitization, reduces the temperature of γ-to α-transformation and lowers by 50° the A_r point. Addition of 2.5 Ni considerably increases the quenching action of the iron, reduces A_c below 700° and causes graphitization at 870°. The addition of 1.37 Ni and 0.34 Cr increases the cementite anomaly and raises the temperature of graphitization, reducing the tendency toward quenching by raising A_r point. Malleabilizing treatments showed that Ni helps to stabilize system by decomposing the cementite. It prevents changes on cooling and decreases the size of the constituents proportionally to its content. Chromium exerts an opposite action. One to two % Ni increases the tensile strength by about 30% and almost doubles the elongation. Toughness also increases, reaching 0.430 kg./m. for 1.5% nickel. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 18. JDG(27)

The Effect of the Addition of Various Elements to Cast Iron. A Review of the Literature. Parts I and II. E. E. MARBAKER. 13 pages. Privately printed by Whiting Corporation, Harvey, Illinois, 1930.

About 30 of the elements in the periodic table have actual or potential use in cast iron. The first of these 2 papers gives a brief general discussion, in which it is pointed out that a base iron of suitable quality in itself must be produced when addition of alloying elements is to be resorted to. The second paper deals with the influence of the individual alloying elements with some 65 references to the literature. The discussion of each element is very brief, but gives references to more detailed discussions in the literature. It is concluded that the possibility of improving cast iron by alloying is still unlimited in spite of the large amount of work already done. HWG(27)

The Effect of Silicon and Manganese on the Solidification of Iron-Carbon Alloys. (Der Einfluss des Siliziums und Mangans auf die Erstarrungsart von Eisen-Kohlenstoff-Legierungen.) O. v. KEIL & F. KOTYZA. *Archiv für Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 295–297; *Stahl und Eisen*, Vol. 51, Jan. 22, 1931, page 106.

Since there can be distinguished in cast iron, according to O. v. Keil, the difference between a stable graphite crystallization and a metastable crystallization with a subsequent decomposition, the effect of Si and Mn on Fe-C alloys with increasing C content was studied with a cooling velocity of 30° C./min. for both fields, the "white" solidification and the primary crystallization of graphite. It is indicated that within the cooling velocities chosen, silicon does not stabilize, but accelerates, the decomposition of cementite. By adding 0.3% Mn, the "white" field increases at the expense of the field of fine grain graphite. At the eutectic C concentration, the coarse leaf-shaped graphite appears. With increasing Mn content, the fine graphite disappears completely at 3.5% Mn. Evidently, at lower C concentrations, Mn favors the stability of the cementite but favors the stable phase at higher carbon contents. GN(27)

The Effect of Titanium on the Transformation Points of Steel. (Einfluss des Titans auf die Umwandlungspunkte des Stahles.) H. HOUGARDY. *Stahl und Eisen*, Vol. 51, Jan. 8, 1931, page 51.

An article by A. Michel and P. Bénazet in *Chimie Industrielle*, Vol. 23, 1923, pages 237–242 is reviewed. The effectof Ti on the α, γ-transformation was studied. The results confirm the results by Wever (*Mitteilungen Kaiser Wilhelm Institute für Eisenforschung*, Vol. 11, 1920, pages 193–223 and also *Stahl und Eisen*, Vol. 49, 1929, pages 1378–1379). The γ-field is closed at even relatively low Ti contents. GN(27)

The Effect of Phosphorus on the Strength of Admiralty Gun-Metal. H. C. DEWS. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 255–277.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 857. (27)

Characteristics of Modern Alloy Chilled Iron Rolls. W. H. MELANY. *Rolling Mill Journal*, Vol. 4, Dec. 1930, pages 669–672.

Cr is one of the common alloying elements used to promote the formation of combined C, thus producing a harder and closer grained surface on the roll. Such rolls are necessary for hot rolling full finished sheets. Softer rolls with a greater amount of graphite C having a reduced grain size are produced by adding Mo or Ni. A type known as "grain roll" in which the combined C is greatly in excess of the graphitic C is generally produced by adding Cr and Mo. In this type, the chilled surface has lost its crystalline structure and has a grain formation, and the apparent chilling effect reaches to a greater depth than usual. The surface is much softer than in the ordinary chilled roll. It offers great resistance to fire cracking, and considerable resistance to abrasion, but is easily machined. It is being applied to the rolling of small sections and to rod-mill work. A Cr-Ni iron roll has been developed but has not met with favor due to the difficulty of machining. The surface is not as hard as was thought at first but it is exceedingly tough. It is very resistant to wear. MS(27)

Addition of Nickel and Chromium for Cast Iron Cylinders of Automobile Engines. (Nickel- und Chromzusatz für Gusseisen-Zylinder von Automobilmotoren.) MAHL. *Automobiltechnische Zeitschrift*, Vol. 33, Feb. 10, 1931, pages 97–99.

Additions of the named elements of gray iron, which is generally used in the manufacture of automobiles, have the following effects: (1) Si reduces the contents of free C, prevents quick cooling and softens the structure; (2) Ni reduces the contents of free C, but hardens the structure; (3) Cr stabilizes free C, increases the cooling and hardens the structure. The most practical values were 1.5% Ni together with 0.4% Cr in American practice, while others use 1.5% Ni with 0.3% Cr or 1% Ni with 0.2% Cr. Ha(27)

Effect of Composition and Structure on the Wear of Cast Iron. (Weitere Untersuchungen ueber den Einfluss der Zusammensetzung und des Gefügeaufbaus auf den Verschleiss von Gusseisen.) T. KLINGENSTEIN (Esslingen Maschinenfabrik). *Mitteilungen aus den Forschungsanstalten, Gutehoffnungshütte Konzern*, Vol. 1, April 19, 1931, pages 80–92.

In order to study the wear of one cast iron upon another, as in the case of piston and cylinder, a flat surface of one cast iron specimen 3 × 3 × 1 cm. is subjected to wear by a flat-ended rotating cylinder of another cast iron specimen 1 cm. diameter, moving at 325 r.p.m. under a pressure of 4 kg. (24 kg./cm.^{2}) as if the rotating cylinder were a drill. The total wear is the sum of the weight losses of both the flat and the cylindrical specimens. Each test was run 10 minutes without lubrication. The iron was cast upright into plates 1.3 × 9 × 15 cm. The effects of pressure and of speed were first studied. Wear increased linearly with increase of peripheral speed, and decreased hyperbolically with decrease in pressure. Individual determinations agreed within 10%. Working on all possible combinations among 3 irons cast both in green and dry sand and containing 3.30% total C 1.75% Si, 1% Mn, 0.40% P, 0.05 to 0.10% S; 3.30%, 1.50%, 1%, 0.40%, 0.10%; and 3.50%, 2.25%, 0.75%, 0.33%, 0.075%, respectively, with Brinell's of about 230 for the first 2 and 185 for the last, it was found that the total wear was least when the 2 specimens had the same hardness, rose as the difference in hardness increased, and that it was somewhat less when the rotating specimen was harder than the stationary one than when these conditions were reversed. These conclusions were checked on a 3.25% total C, 1.15% Si iron of 243 Brinell, working against itself and against the other specimens, but the curves for the softer irons were concave upward when wear loss is plotted vertically, and difference in hardness horizontally, while when the 243 Brinell iron was used, they were convex upward. For a given hardness difference the wear was less the harder the irons used. This is discussed in relation to pistons, piston rings and cylinders, and it is concluded that they should all be made of the same iron, but if not, the moving part should be the harder. Better surface structure to resist wear is obtained at 220 Brinell than at lower hardness. The effect of temperature upon wear up to 250° C. is not appreciable, save for a slight increase in wear with rising temperature with one iron containing 1.90% P. The influence of alloying elements was studied and curves for wear as cast, and after annealing 3 hours at 900° C. are given. In both cases increase of Si increased wear. Ni had no effect one way or the other, and increase of Mn had practically no effect. In the as-cast state P notably decreased wear, but in the annealed state it did not until more than 1¼% was present. With as-cast specimens Cr had no effect until more than ¼% was present, but in annealed specimens it showed its effect in smaller quantities. The greatest decrease in wear was found when Cr was added. Since Ni alone has no effect, it is the Cr in Ni-Cr irons that produces wear-resistance. The curves showing the effect of alloying elements on wear-resistance are plotted from a small number of compositions. HWG(27)

Vanadium Additions Improve Steel. N. PETINOT (Vanadium Corp. of America). *Steel*, Vol. 87, Aug. 21, 1930, pages 43–45, 48; Aug. 28, 1930, pages 47–49; Sept. 4, 1930, pages 56–57, 60.

Paper presented to the Sixth International Congress of Mining, Metallurgy and Applied Geology, Liege, June 22–28, 1930. French translation is credited to S. B. Saklatwalla, J. Strauss, H. Chandler and G. Morris. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 19. MS(27)

INSTRUMENTS & CONTROLLERS (28)

A Precision Time Switch for X-Ray Tube Circuits. WILLIAM K. KEARSLEY. *General Electric Review*, Vol. 34, Feb. 1931, pages 127–128.

The modern mechanical type of time switch for radiographic outfits consists of a small motor with a gear train and small contacts serving to close and open a circuit that in turn operates a switching device in the supply circuit. A new form of timer operating on this principle is illustrated. Outstanding features are: (1) high precision; (2) ease of setting; and (3) quiet operation. Each feature is discussed. WHB(28)

Measuring, Signaling and Control Installations in the Blast-Furnace Plant Essen-Borbeck of Fried. Krupp. (Die Mess-, Signal- und Regelanlagen des Hochofenwerks Essen-Borbeck der Firma Fried. Krupp Aktiengesell schaft.) P. OSTWALD & W. LIESEGANG. *Siemens-Zeitschrift*, Vol. 11, Feb. 1931, pages 49–56.

Detailed description of location and kind of instruments used in this new plant for indicating, recording and measuring of gases and air in the operation of two blast-furnaces of 600 tons per day; there are 31 places where instruments are placed which are all wired for remote reading in the control observation room. Ha(28)

Radiation Pyrometry. E. L. FIDGE (Workingmen's College, Melbourne). *Chemical Engineering & Mining Review*, Vol. 23, Feb. 5, 1931, pages 189–941, 7 references.

Temperature measurement instruments are placed in 2 general groups which primarily depend for operation on the transfer of heat by conduction and radiation, respectively. The first type does not lend itself to the determination of temperature of a given inaccessible place nor for the temperature determinations of objects of small mass. There are 2 main types of radiation pyrometers: The total radiation pyrometer which uses the whole spectrum of radiation from a hot body, and the spectral radiation or optical pyrometer operating on a selected part of the total spectrum. The latter type may be further divided into: (1) the disappearing filament (Morse type); and (2) the polarization pyrometer (Wanner type). Characteristics of the various types are noted and certain mathematical derivations made. WHB(28)

Photoelectric Control for Soaking-Pit Covers. R. M. BAYLE. *Electrical World*, Vol. 97, Feb. 28, 1931, page 409.

A Middle West plant has a soaking pit control which makes use of a light-sensitive relay as the initiating source. The moving crane carries only a foot-operated push button and a light box mounted on the end of the crane for each soaking pit spanned by the crane. The layout consists of 2 soaking pit cranes operating on a common runway and each spanning 2 pits. Preparatory to opening a cover or during the operation the crane may be shifted 5 ft. on either side of the center line and the operating lamp box will be opposite the light relay for that cover. To open the cover a single short flash of the lamps in the light box is all that is necessary. The circuit is self-maintaining. A simple transfer circuit permits the light ray to be alternately effective to open or close the pit cover. The light-sensitive cells respond only to concentrated light above the room illumination, leaving no danger of false operation. WHB(28)

Recording Dust Concentration Meter for Blast Furnace Gas. A. W. SIMON (Tennessee Coal, Iron & Railroad Co.). *Blast Furnace & Steel Plant*, Vol. 19, Nov 1930, pages 1686–1689, 1700.

Paper read before the American Iron and Steel Institute. MS(28)

A Vacuum Tube Time Switch. WILLIAM K. KEARSLEY. *General Electric Review*, Vol. 34, Feb. 1931, page 128–129.

A photograph of a laboratory set-up of the apparatus comprising the vacuum-tube time switch is shown, also a diagram of connections of the time switch coupled to an X-ray generator. Two thyratron tubes and a glow tube are used together with a condenser and 4 resistances. The only moving part is a 4-blade double-throw control switch. The advantages of this type of timer are its mechanical sturdiness, precision and reliability. WHB(28)

Lubricants and Bearing Test Machine. E. S. GLAUCH (Jos. Dixon Crucible Co.). *Iron & Steel Engineer*, Vol. 8, Mar. 1931, page 129.

An illustrated description of a specially designed test machine that takes a load up to 37,300 lbs. on the bearings on which either lubricant or bearing is being tested. Speed can be varied and loads applied to suit. WHB(28)

Contact Pyrometers. (Anlege-Pyrometer.) W. CLAUS & R. HASE. *Zeitschrift für Metallkunde*, Vol. 23, April 1931, pages 120–123.

The necessity of temperature measurements on the surface of solid bodies is emphasized, theoretical conclusions are drawn, and the accomplishment of those measurements and the necessary instruments are considered. EF(28)

Temperature Measurement of Molten Cast-Iron. (Temperaturmessungen an flüssigem Gusseisen.) J. MOELLER. *Die Messtechnik*, Vol. 7, Apr. 1931, pages 93–96.

After a discussion of the importance of the temperature measurement of the liquid cast-iron the three principal measuring methods are described and compared: thermoelectrical pyrometer, total radiation pyrometer, partial radiation pyrometer; the latter type is considered to be the most practical. As an example for the latter the "Pyropto" of Hartmann & Braun is described. From measurements with an instrument of the latter type the following emission coefficients of iron have been found: iron, solid, polished, 0.45; iron, liquid, bright, 0.40; iron, solid, in air (below 137° C.) 0.90; iron oxide 0.90; lead bath (slag) about 1.0; salt baths, about 0.80. These figures give the difference between the radiation of a black body and the not completely black body. A diagram is given from which the corrections for temperatures up to 2000° C. can be taken directly. Ha(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The Tensile Properties of Alloy Steels at Elevated Temperatures as Determined by the "Short-Time" Method. WILLIAM KAHLBAUM, R. L. DOWDELL & W. A. TUCKER. *Bureau of Standards Journal of Research*, Vol. 6, Feb. 1931, pages 199–218.

By means of "short-time" tension tests a series of alloy steels has been tested at different elevated temperatures. The proportional limit was determined in each case. The materials tested were a plain carbon steel and commercial alloys of chromium, vanadium and iron with and without additions of tungsten, silicon or aluminum; also chromium-tungsten, nickel-molybdenum and several austenitic steels with and without tungsten. Metallographic study revealed very little intercrystalline weakness and no marked or significant change in structure resulting from the high temperature tests. The addition of tungsten increases the "structural stability" of the austenitic alloys. Hardness was determined as a further indication of tempering which might have occurred during the heating. A comparison of "short-time" test and "flow test" for pearlitic and austenitic steel is included. (29)

Mechanical Properties of High-Speed Steel at Elevated Temperatures. A. R. PAGE (Birmingham Central Labs.). *Metallurgia*, Vol. 1, Apr. 1930, pages 239–241.

Tensile tests at temperatures up to 950° C. were made on annealed, underhardened, correctly hardened and overhardened 14% W high-speed steel. The annealed steel began to soften rapidly at about 500° C. At 900° or 950° C. there was a drop in elongation and reduction in area that indicated a brittle range. The strength of the underhardened steel was high, 136 tons/in.^{2} at room temperature. It fell gradually to 500° C. and then rapidly. In the correctly hardened steel the strength did not fall rapidly until 600° C. was reached, and at 650° C. the strength was 70 tons/in.^{2} In the overhardened steel the strength was low at all temperatures, and it appeared to have no ductility. Hardness tests were made on the steel in the several conditions. The correctly hardened steel after having been tempered at 600° C. did not decrease in hardness after holding for 30 min. at 650° C. JLG(29)

Some Experiments on the Impact Hardness of High-Speed Steel at Elevated Temperatures. A. R. PAGE. *Metallurgia*, Vol. 3, Jan. 1931, pages 85–86.

Impact hardness values were obtained at temperatures up to 800° C. In hardened untempered steel a minimum hardness occurs at 400° C., and a maximum at 550° C., above which there was a rapid softening. The behavior of the underhardened specimen is similar except that the maximum occurs at 500° C. In a tempered specimen there is a slight decrease in hardness up to about 600° C., then a rapid decrease. JLG(29)

Some Long-Time Tension Tests of Steels at Elevated Temperatures. J. J. KANTER & L. W. SPRING. *Proceedings American Society for Testing Materials*, Vol. 30, Part 1, 1930, pages 110–132.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 50. HWG(29)

The Strength of Gray Cast Iron at Elevated Temperatures. J. W. DONALDSON. *Journal West Scotland Iron & Steel Institute*, Vol. 38, Nov. 1930, pages 11–20.

Cast irons comprising 2 plain irons containing 0.65% and 1.48% Si respectively, alloy irons containing 2.43% Mn, 0.40% Cr, 0.75% Ni, 0.12% V, 0.48% W, and 0.61% Cr, 0.30% Ni, 0.02% C, respectively, were investigated to determine (1) the temperature-stress curves of a series of plain and alloy irons, (2) the influence of previous heat treatment on the temperature-stress curves, and (3) the effect of low Si and various alloy additions on the strength of cast Fe at elevated temperatures both as cast and after heat treatment. (29)

Creep of Metals at Elevated Temperatures. P. G. MCVETTY. *Mechanical Engineering*, Vol. 53, Mar. 1931, pages 197–200; *Iron Age*, Vol. 127, Mar. 12, 1931, pages 868–870, 919.

In the past 6 or 7 years the term "creep" has become familiar to all engineers. In its simplest form we may think of a vertical cylindrical rod supported at the top, carrying a constant load at the bottom, and heated to some constant high temperature over a definite portion of its length. If means are provided for measuring with great accuracy any change in length of the section in which stress and temperature are maintained constant, data may be obtained from which the usual creep curve can be plotted. The author discussed the probable nature of creep phenomena, the various forms of creep curves, the metallurgical aspects, the significance of creep to the designer of parts to withstand high temperatures, and concludes that the collection of reliable creep data for the numerous metals and alloys now available will require many years. In the meantime it is probable that extensive service applications will be made without having complete data on creep phenomena. These are, in themselves, the best kind of tests if accurate records are kept, and it is hoped that all such data will be carefully preserved and published. MFB(29)

The Strength of Steels at High Temperatures. H. A. DICKIE. *Royal Technical College Metallurgical Club Journal*, Glasgow, No. 7, 1929–1930, pages 32–37, 10 references.
Brief general discussion. HWG(29)

Progress in the Manufacture of Alloy Steels. S. J. HEWITT. *The Industrial Chemist*, Vol. 7, Jan. 1931, pages 19–20.
A brief review in which considerable attention is given to a paper read before the Iron and Steel Institute by Dr. W. H. Hatfield on "Permanence of Dimensions under Stress at Elevated Temperatures" giving the results of tests carried out on a large number of alloy steels in common use, to determine the safe stress at temperatures between 300° and 700° C. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 798. MPB(29)

Report on Hot-Hardness Characteristics of Some Modern Tool Steels and Alloys. E. G. HERBERT. *Proceedings Institution of Mechanical Engineers*, No. 3, May 1930, pages 681–692.
Report of the Cutting Tools Research Committee. Presents a chart showing the hardness of "Widia," nitrated, high speed, high carbon steel superhardened high speed steel, S. O. B. V. steel superhardened by cloudburst, S. O. B. V. normally hardened. Studies were made of the depth of hardening and the effect of superhardening by cloudburst and by pendulum work hardening. RHP(29)

Physical Properties and Behavior of Cast Iron at High Temperatures and at Various Conditions of Stress. (Festigkeitseigenschaften und Verhalten von Gusseisen in der Wärme und bei verschiedenen Spannungszuständen.) R. MAILÄNDER. *Stahl und Eisen*, Vol. 51, Jan. 22, 1931, pages 106–108.
The author reviews 3 Swiss publications on the above subject, E. Dübi, Discussion Report 37, 1928, pages 7–18, Eidgenössiche Materialprüfungsanstalt, Technische Hochschule Zürich; E. Honegger, Discussion Report 37, 1928, pages 21–36, Eidgenössische Materialprüfungsanstalt, Technische Hochschule Zürich, and M. Ros & A. Eichinger, Discussion Report 37, 1928, pages 39–64, Eidgenössische Materialprüfungsanstalt, Technische Hochschule Zürich. GN(29)

Effects on Cast Iron of Prolonged Heating at 800–1100° Fahrenheit. R. S. MACPHERRAN & REXFORD H. KRUEGER. *Transactions & Bulletin American Foundrymen's Association*. Vol. 2, Feb. 1931, pages 826–864.
Various types of cast iron were heated for 500 hours at 800° to 1100° F. and were afterward tested for chemical composition, strength, Brinell hardness and deflection. High Si and Ni accelerates decomposition of pearlite. The action is slower with low Si, low C and Cr. Tables and graphs of data are given. See also *Metals & Alloys*, Vol. 2, June 1931, page 122. CHL(29)

LEACHING (30)

The Action of Sulfur Dioxide on Manganese Oxides at Elevated Temperatures. C. W. DAVIS. *Bureau of Mines Report of Investigations* 3033, Oct. 1930, 16 pages.
There is little advantage in roasting Mn minerals in a SO_2 atmosphere since dissolution in SO_2 solutions is so satisfactory. The rate of manganese sulphate decomposition to oxides after evaporation increases with temperature. At 950° complete conversion takes place in 30 minutes. If the air above roasting zinc sulphide ore containing manganese contains 5% SO_2, in 4 hours manganous oxide, manganese sulphate and 40% manganese dioxide will be formed. The manganese sulphate can be recovered by a water leach, the manganous oxide and manganese dioxide by sulphuric acid. Since the higher oxides of Mn are often added to solutions of Zn salts before electrolysis to oxidize the Fe salts, the manganese dioxide would be doubly useful. AHE(30)

Note on the Extraction of Copper from Oxidized Ores by Cyanide Solution. E. T. DUNSTAN. *Journal Chemical, Metallurgical & Mining Society of South Africa*, Vol. 31, Jan. 1931, pages 190–194.
Cyanide extraction of a malachite ore from Katanga containing 9.36% Cu resulted in high cyanide consumption. Regeneration electrolytically was impossible. Details are given. AHE(30)

Electrolytic Copper from Copper Concentrate. WM. E. GREENAWALT. *Engineering & Mining Journal*, Vol. 129, Mar. 1930, pages 241–244.
Leaching and electrolysis can solve every problem on almost all copper concentrates, but certain fundamentals must be observed to compete with or to supplant smelting: (1) roasting to get a satisfactory extraction by leaching, comparable with slag losses in smelting; (2) proper control of ferric ion in electrodeposition of the copper from copper solutions containing salts of iron; (3) the recovery of lead and the precious metals, if contained in appreciable amounts, in the copper concentrate. Roasting, leaching and electrolysis are discussed, and a revised flow sheet is shown. WHB(30)

Extraction of Tantalum and Columbium from Their Ores. COLIN G. FINK & LESLIE G. JENNESS (Columbia University). *Technical Publication* No. 379, *American Institute of Mining and Metallurgical Engineers*, 1931, 18 pages.
Describes methods developed for extraction. Tantalum and columbium occur together in tantalite and columbite ores. These 2 elements can be extracted by leaching with HF, but the addition of oxalic acid increases the efficiency of the HF solution. The HF can be produced from CaF_2 and H_2SO_4. The method appears to be commercially practicable. Methods for extracting the metallic salts from the leaching solution are given. 5 references. JLG(30)

Leaching Copper Ores: Advantages of Wet-Charging. JOHN D. SULLIVAN & ALFRED P. TOWNE. *Bureau of Mines Report of Investigations* 3050, Feb. 1931, 26 pages.
Charging the ore into the leaching vat in the wet condition increases the extraction of Cu. Virtually identical extraction was obtained by upward and downward percolation when the solutions were not continuously circulated. In the latter case, extraction was greater on downward percolation. Virtually identical extraction resulted from flood and trickle leaching when the ore was wet-charged. With dry charged ore, extraction was greater from +100-mesh ore than from unsized material containing fines; there was no difference when the ore was wet charged. AHE(30)

Oxygen as an Aid in the Dissolution of Silver by Cyanide from Various Silver Minerals. E. S. LEAVER, J. A. WOOLF & N. K. KARCHMER. *Bureau of Mines Report of Investigations* 3064, Jan. 1931, 15 pages.
Cerargyrite is completely soluble in cold cyanide solution in 8 hours. Practically all the Ag in stetefeldtite is dissolved by cold cyanide in 24 hours. Argentite, polybasite, stephanite and pyrargyrite are slowly soluble under the usual conditions of cyanidation. Their rate of dissolution is materially increased by supplying additional oxygen. Proustite, similar in composition, did not show any material increase in extraction by use of oxygen. By a preliminary low-temperature roast, an extreme case of oxidation, the resulting calcines yield an extraction of 90% of the Ag by cyanidation. Tetrahedrite is the most refractory mineral tested. Direct cyanidation, even with excess oxygen, gave less than 25% extraction. Preliminary roasting increased this figure. In general, oxygen is an aid in the treatment of Ag minerals by cyanidation. Warm solution also increases the dissolution rate. Low-temperature roasting is usually effective if the preceding fail. Usually 72 hours or more are required for maximum dissolution of Ag by cyanidation. AHE(30)

REDUCTION METALLURGY (31)

Retreatment of Mother Lode (California) Carbonaceous Slime Tailing. EDMUND S. LEAVER & JESSE A. WOOLF. *Technical Paper* 481, *United States Bureau of Mines*, 1930, 20 pages.
Gives results of Bureau of Mines experiments with slimes and tailings from the Mother Lode district. The present method of recovering the free Au by amalgamation could be improved on by installing a modern flotation department, which would soon pay for itself. AHE(31)

Copper and Zinc in Cyanidation Sulphide-Acid Precipitation. EDMUND S. LEAVER & JESSE A. WOOLF. *Bureau of Mines Technical Paper* 494, 1931, 63 pages.
All of the common Cu minerals except chrysocolla and chalcopyrite are sufficiently soluble in cyanide solution to cause excessive reagent loss (2 to 3 lbs. NaCN/lb. copper) unless the cyanide combined with the Cu is regenerated. The Na_2S-H_2SO_4 method regenerates an average of 80% of the cyanide from solutions used to treat precious metal ores containing up to 0.5% cyanide soluble Cu. Solutions used to treat cuprite or metallic Cu give large regeneration. The more complex the Cu mineral treated, the less cyanide will be regenerated from the resulting solution. The more nearly all the cyanide is combined with Cu and the less is uncombined (free) cyanide, the greater will be the regeneration. The amount of Na_2S used varies with the amount of metals precipitated. The acid consumption varies with the strength of the original solution in both cyanide and lime. The Ag may be precipitated separately from the Cu before the solution is acidified. The Cu sulphide must be removed from the acid solution as it redissolves in alkaline cyanide solution. Only a small amount of Au is precipitated by the Na_2S-H_2SO_4, most must be removed by Zn as usual. Cu in cyanide solution up to 10 lbs./ton does not diminish the activity of the solution as a solvent for Au and Ag if the requisite free cyanide is present. The double Na-Cu cyanide solution, in the absence of free cyanide, is only a weak solvent for the precious metals and is more effective for Au than Ag. Smithsonite, hydrozincite, zincite and calamine are soluble enough under the usual conditions of cyanidation to cause rapid accumulation of Zn in the solution unless special precautions are taken to remove it. Willemite, sphalerite and franklinite are dissolved more slowly. From 1.5 to 4.0 lbs. NaCN is needed per lb. Zn dissolved. The various Zn cyanide compounds are only weak solvents for the precious metals, even if Ag nitrate titration shows free cyanide. Addition of excess lime or caustic soda improves extraction by liberating free cyanide from the double salt. If most of the cyanide present in a solution is combined with Zn, more free cyanide must be added to this solution than to a fresh solution for the two to have equal activity as solvents. Na_2S-H_2SO_4 treatment will remove Zn and regenerate cyanide. When ores containing soluble Zn minerals are treated, the solution must contain excess free cyanide or the dissolution of Zn will decrease Ag extraction. The Welch method was thoroughly tried and seems to apply only to Au ores or to Au-Ag ores containing not over 0.1% of cyanide-soluble Cu and in which Ag occurs as a haloid mineral. AHE(31)

The Reduction of Iron Ores in Smelting Furnaces and the Structure of the Cast Product. J. E. FLETCHER. *Iron & Steel Industry & British Foundryman*, Vol. 3, July 1930, pages 295–298; Aug. 1930, pages 335–338.
A new view of alloying reactions in the blast-furnace is advanced. Molten pig iron is a mixture of carburized sponge iron and an alloy of iron with Si, Mn and P. The author concludes that the reactions occur at the slag-metal interface. CHL(31)

Burdening the Blast Furnace. ROY P. HUDSON. *Rolling Mill Journal*, Vol. 4, Sept. 1930, pages 485–488; Nov. 1930, pages 601–604.
Describes methods for the calculation of blast-furnace burdens. Intended primarily for the furnaceman. MS(31)

Reduction of Zinc Oxide by Methane or Natural Gas. H. A. DOERNER. *Report of Investigations* No. 3091, United States Bureau of Mines, Apr. 1931, 14 pages.
$ZnO + CH_4 = Zn(gas) + CO + 2H_2$ is nearly complete when equilibrium is attained (0 gas velocity) at about 927° C. The reaction rate increases with temperature, but CO_2 formation and subsequent reoxidation of Zn also increase. Temperatures should therefore be kept below 1000° C. Crude natural gas gives approximately the same results as methane, the higher reducing power of the homologues of methane being compensated by their greater tendency toward thermal decomposition. A preliminary treatment to remove (sulphate) sulphur is advantageous. This may be accomplished by heating the calcine at 800° C. in an atmosphere of natural gas or the gaseous products from the Zn condenser. Cd may also be eliminated by this step. In the temperature range 975–1000° C. the rate of Zn distillation compares favorably with that obtained from retorts by standard practice, the metal produced is of exceptional purity and no appreciable amount of blue powder is formed. The special requirements of a furnace for commercial reduction of Zn by natural gas are (1) a retort and condensing system as nearly gas-tight as possible, (2) continuous feed and discharge of ore at a slow rate (time of residence, about 34 hours), (3) continuous counterflow of gas at a low velocity (time of contact, about 1 minute), (4) retorts having a large capacity, and (5) pretreatment of the ore in a separate retort at 800° C. or lower with gas from the Zn metal condenser. Under these conditions Cd and S are volatilized and Fe is reduced to metal. The length of the retort is limited by the resistance of the ore to the flow of gas and by the necessity to prevent transportation of dust incident to the higher gas velocity required by long retorts if the time of contact is constant. The smallest dimension of the retort will be limited by the requirements of heat transfer. The relatively low operating temperature and the presence of the excellent thermal conductor, H_2, facilitate the flow of heat and permit large units to be used. AHE(31)

Graphical Carbon Balance of the Blast Furnace. T. J. ESS (Republic Steel Corp.). *Iron & Steel Engineer*, Vol. 8, Apr. 1931, pages 173–176.
Charts developed to facilitate a check on gas production, blast volume and furnace practice are shown and the application is explained in determining the carbon balance. The balance worked through analytically agrees substantially within slide rule limits. WHB(31)

Smelting Secondary Aluminum and Aluminum Alloys. ROBERT J. ANDERSON. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, pages 555–556.
This installment being part 10 of a series started in 1925. Describes furnace tools used in secondary practice such as pig tongs, spout plug, rabbling hoe, skimmers, etc. VSP(31)

Machine Cast Pig Iron Has Greater Uniformity. F. B. RIGGAN & L. S. MORGAN. *Steel*, Vol. 87, Dec. 18, 1930, pages 60, 63.
An important improvement in southern pig-iron has been the installation of pig casting-machines. Pigs, however, broke easily. This difficulty has been eliminated by spraying the hot empty molds with a heavy coating of CaO and NaCl and allowing the molten Fe in the molds to cool in transit to about 1600° F. before subjecting it to H_2O spray. The coating effects a slight desulphurization. The newer pig-iron is held for some time in large mixer-type ladles, and thus has an opportunity to cleanse itself. Slag is removed by 3 skimming operations, before the metal enters the traveling molds. Pigs have a smooth, clean surface and uniform fracture as well as being no longer easily broken. MS(31)

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MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

801 **X-Ray Inspection.**—The Claud S. Gordon Co., 708 West Madison St., Chicago, Ill., is prepared to X-ray steel, iron, brick, clay, wood and any metal up to a thickness of $3^1/_2$ inches for steel and 8 to 9 inches for aluminum. Such items as patterns, tools, dies, castings, raw materials, etc., may be examined. This service is described in a leaflet, "Secrets of Metal," recently issued by them.

802 **A-C. Welder.**—A leaflet, No. 20522, entitled, "Flex Arc A-C Welder" has been announced by the Westinghouse Electric & Manufacturing Co. This unique welder meets the great demand for the economical arc welding of such gage material as encountered in the manufacture of metal furniture sheet steel cabinets, air-craft fabrication, job and garage repair work and erection of ventilating systems and materials handling equipment of many kinds.

803 **Melting Furnaces.**—Catalog No. 6 of the Bellevue Industrial Furnace Co., 2971 Bellevue Ave., Detroit, Mich., lists and illustrates various sizes of their brass and aluminum melting and crucible heating furnaces and accessories designed to supply standard equipment for melting non-ferrous metals.

804 **pH Comparator.**—A new Nickel pH Comparator is discussed in a leaflet sent out by the Kocour Co., 4724 South Turner Ave., Chicago, Ill. The set is described and detailed instructions for its use are given. The same company also advertises analytical sets for chloride in nickel solutions and for determining sulphuric acid and copper sulphate in acid copper solutions.

805 **Cutout.**—The Hevi-Duty Automatic Excess Temperature Cutout is a protective unit for furnaces. This is intended to replace the excess temperature fuse or link in the furnace control circuit. It is discussed in a sheet sent out by the Hevi-Duty Electric Company, Milwaukee, Wis.

806 **Electric Furnaces.**—The Hevi Duty Electric Co., Milwaukee, Wis. has issued several bulletins on their different types of electric furnaces. Bulletin 430 is devoted to Box Type Electric Furnaces. Bulletin 230 is on Conveyor Furnaces. Bulletin 530 discusses the Rotary Retort Furnace and Bulletin 930 describes the Pot Type Furnace.

807 **Piping and Valves.**—Bulletin No. 44 of the Semet-Solvay Engineering Corp., 40 Rector St., New York, N. Y., covers their piping and valves. It contains suggestions for efficient planning of new piping and diagrams of operating arrangements for gate valves, as well as tables of standards for the different pipe sizes.

808 **Alloy Steels.**—According to Bulletin No. 31-2 sent out by the Wehr Steel Co., Milwaukee, Wis., their engineers will obtain alloy steel castings to fill a particular analysis and will heat treat them to any specifications. The physical analyses of the Wehr steels are given.

809 **Blast-gates.**—The W. S. Rockwell Co., 50 Church St., New York, N. Y., has sent out a leaflet, No. 303, describing their air-tight blast-gates. The illustrations show different types of control and several tables give their dimensions. Leaflet No. 306 gives a brief description of their non-oxidizing annealing furnace.

810 **Automatic Reversal of Open-hearth Furnace.**—Copies of a new bulletin, No. 841, explaining automatic reversal of open-hearth furnaces and the improvements it can effect in open-hearth performance, are available through the Leeds & Northrup Company of Philadelphia. Every phase of L & N Automatic Reversal is covered in this bulletin—how reversals are made automatically—what the system is—how it operates—and its advantages.

811 **Refractory Materials.**—Corundite Refractories, Inc., Massillon, Ohio, have compiled a catalog containing valuable information in connection with the use of standardized clay fire brick and super-refractories. The last half of the catalog contains useful tables showing the number of shapes of brick required for different size furnaces.

812 **Grits & Grinds.**—An attractive new make-up is a feature of the May issue of this publication of the Norton Company, Worcester, Mass. The subject to which it is devoted is "Putting the Shop in Order Increases Plant Capacity." It includes a number of interesting illustrations and diagrams.

813 **Potentiometer Pyrometer.**—An attractive 12-page folder has just been issued by the Brown Instrument Co., Philadelphia, Pa., showing in tabloid form the principal features of their new potentiometer. Extreme accuracy and ruggedness is claimed for this new instrument and the folder shows many of the constructional features substantiating this claim. The folder is arranged for easy reading and gives a good idea of the instrument illustrated.

814 **Hardometer.**—The Firth Hardometer is now handled in the United States by the Tinius Olsen Testing Machine Co. and this company has prepared a booklet describing the instrument. It extends the reliable Brinell method for use with thin materials, case hardened or nitrided surfaces, small parts, or any condition where a small indentation is necessary or desirable.

815 **Electric Furnaces.**—Bulletin No. 260 sent out by the H. O. Swoboda Company describes their continuous furnaces for heat treating ferrous as well as non-ferrous strip metal and wire. Circular No. 228A by the same company gives a general description of their straight line continuous electric furnace equipments for hardening and tempering steel.

816 **Welding.**—The American Steel & Wire Company has compiled a booklet called "The Welder's Handbook." In it they discuss electric arc welding, as to selection of electrodes, arc length, welding current, etc. A few pages are devoted to gas welding and the remainder of the booklet is given over to illustrations of the various types of welding wire and electrodes.

817 **Wire Cloth.**—The Newark Wire Cloth Co., 351 Verona Ave., Newark, N. J., has published a leaflet illustrating the different meshes and weaves of their product. This company originated metallic filter cloths which cannot be excelled for some filtering purposes and are indispensable for others.

818 **Silver.**—A compact little book has been gotten up by the Handy & Harman Company. It is entitled "Review of the Silver Market for 1930" and gives not only an economic history of this metal for last year but gives the figures for its world production and consumption for 1929 and 1930.

819 **Welding.**—An interesting article on oxwelding brass and copper piping will be found in the June issue of "Oxy-Acetylene Tips." In this same issue there are also several articles on repair work done by welding, and a page listing new developments in this field.

820 **Testing Machines.**—A mimeographed pamphlet from the Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa., gives the specifications of their Precision Hydraulic Universal Testing machine. The machine is built in three distinct units; the loading unit, the indicating unit and the power unit. Each of these is discussed separately and fully.

821 **Facts for Foundrymen.**—The second edition of this handy little book gotten out by the Niagara Falls Smelting & Refining Corporation, 2204 Elmwood Ave., Buffalo, N. Y., has just been received. It is bound in stiff boards, is pocket-size and gives a useful description of various metals and alloys that may assist in the production of more perfect castings.

822 **Nickel Steel.**—The International Nickel Company has issued numbers 1 to 8 of its Recommended Specifications for nickel alloy steel in railroad applications. These cover Forging Billets, Normalized and Tempered Low-Carbon Forgings, Boiler and Firebox Plates, Castings, Nickel Engine Bolt Steel, Low-Carbon Main Frames for Locomotives, Nickel Staybolt Steel and Nickel Cast Iron for Cylinders. These are put out in leaflet form and are punched for filing.

823 **Welding Rod and Equipment.**—Joseph T. Ryerson, Inc., have recently issued a bulletin in which the newer types of welding rod and equipment are illustrated. The first pages contain information on gas and electric welding rods. The second section is devoted to the subject of acetylene and welding equipment. This includes many improvements which have broadened the field of welding. This is Bulletin W.

824 **Steels.**—The Wehr Steel Company, Milwaukee, Wis., has printed a leaflet giving the physical analyses of established Wehr steels. This shows the tensile strength, yield point, elongation, reduction of area, Brinell and scleroscope qualities of their steels in the annealed, and heat treated and drawn states.

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METALLURGICAL ABSTRACTS, incorporated in METALS & ALLOYS, is the most complete review of metallurgical literature (periodicals, books, etc.) available. Fifty-seven section editors and abstractors cover over 400 domestic and foreign publications and abstract the articles on metallurgical engineering as well as allied subjects.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform with our style they are classified. The section editors edit the abstracts appearing in the section in which their major interest lies.

There are usually at least two places where an abstract might fit, sometimes even more, and so we decide who will be most interested in the article. We want the abstracts to be so arranged that if a heat treater reads only Section 10 he will keep in touch with all the important articles in his field and if a foundryman will read Section 22 each month he will not miss anything important. An improvement we hope to make in the METALLURGICAL ABSTRACTS in the near future is the cross-indexing of articles, which belong under several sections. Some of the sections are descriptive and some are self-explanatory and we have so labeled them.

CLASSIFICATIONS

0 (General). Under this heading we classify all abstracts which are of interest to the metallurgical industry in general. Compare this with Section 20—miscellaneous.

1, 2, 3 (Properties of Metals, Non-Ferrous and Ferrous Alloys). An article goes under one of these heads when the properties are emphasized and not the method of determining them.

4 (Corrosion, Erosion, Oxidation, Passivity & Protection of Metals & Alloys). This takes articles on weather resistance, resistance to acids, etc., and protection against them.

5a (Structure of Metals & Alloys—Metallography & Macrography). An article would go in this group if it discussed the microscopic or macroscopic study of metals and alloys, or the determination of constitutional diagrams, critical points, etc.

5b (Structure of Metals & Alloys—Structure and X-Ray Analysis). This group includes articles dealing with the structure of metals and alloys as determined by X-ray analysis and X-ray examination.

6 (Physical, Mechanical & Magnetic Testing). If an article emphasizes the method of determining the properties of metals rather than the properties them-

selves it belongs in this section. The abstracts on fatigue appearing under this section are prepared with the coöperation of the Fatigue Research Committee of the American Society for Testing Materials.

7a (Electro-Chemistry—Electroplating). This will include articles on the electrolytic plating of metals.

7b (Electro-Chemistry—Electrometallurgy). This relates to the electrolytic recovery and refining of metals.

8 (Metallic Coatings Other than Electroplating). Articles on galvanizing, metal spraying or dip coating would come in this group.

9 (Industrial Uses and Applications). If the application of the metal is stressed rather than the properties the article belongs in this section.

10 (Heat Treatment). If heat treatment in general is discussed the article would be classed under section 10; if, however, any distinct operation is stressed it would go under the corresponding subhead.

11 (Joining of Metals and Alloys). The explanation for this group is similar to that for section 10.

12 (Working of Metals & Alloys). We feel that the divisions in this group are self-explanatory to men in the metals industries. We might say, though, that an article is classified under 12j (Cold Working) only when it will not fit under one of the other heads—for instance, an article on cold rolling would be put under 12c, rolling.

13 (Defects). This section includes articles dealing with inclusions, segregations, cracks, pinholes, blowholes and failures.

14 (Chemical Analysis). If the method of analysis is emphasized the article goes here.

15 (Historical & Biographical). Self-explanatory.

16 (Economic). Articles in this group are devoted to economic trends, savings, cost estimates, etc.

17 (Plants & Laboratories) This section includes descriptive articles.

18 (Machinery & Supplies). This includes descriptive articles.

19 (Bibliographies). Self-explanatory.

20 (Miscellaneous). This takes in all scattered articles which do not belong anywhere else.

21 (Laboratory Apparatus). Purely descriptive articles belong here. If results or processes are given they would go under 6 or 14.

22 (Foundry Practice & Appliances). This is self-explanatory.

23 (Furnaces & Fuels). This takes in descriptive articles. Otherwise they go under 10, heat treating, 10b, annealing, etc.

24 (Refractories & Furnace Materials). This section is hand-in-hand with 23. Furnace men should read both of them.

25 (Gases in Metals). This is self-explanatory.

26 (Inspection). This includes articles dealing with inspection, pure and simple—not X-ray or microscopic analysis.

27 (Effects of Elements on Metals and Alloys). Articles dealing with the effect of the addition of different chemical elements to metals and alloys are included in this group.

28 (Instruments & Controllers). Descriptive.

29 (Effect of Temperature on Metals and Alloys). This section is prepared in conjunction with the Joint High Temperature Committee of the A. S. T. M. and the A. S. M. E.

30 (Leaching). Self-explanatory.

31 (Reduction Metallurgy). This would include articles on blast furnace practice.

32 (Non-metallic Coatings for Metals and Alloys). Articles discussing painting, enameling, lacquering, etc., belong here.

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It has been our purpose in this outline to make our scheme of classification apparent to our readers and so, perhaps, make the abstract section more useful. If you have any questions pertaining in any way to the abstracts, write to us. We shall be glad to answer them in detail.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

GENERAL (0)

Progress in the Iron and Steel Industry in 1930. Report of the Executive Committee, Iron & Steel Division, American Society Mechanical Engineers. *Mechanical Engineering*, Vol. 53, Jan. 1931, pages 48–50.

It is found that considerable progress has been effected in spite of adverse influences. Outstanding in its contrast to the general depression of the industry as a whole, is the extraordinary activity in the large-pipe or tube branch of the industry. One bright feature of the situation is the opening of research departments in a number of steel plants, although the amount of research actually carried on has been curtailed by the usual tendency of the steel industry in dull times to reduce expenditures for everything not considered directly productive. The report deals successively with blast furnaces, open-hearth furnaces, rolling mills, furnaces, alloy steels, structural steels, forging, welding, wrought iron, cast iron, surface treatment, billet chipping, machining, testing, and with miscellaneous developments. The Executive Committee notes especially the progress of Instrumentation. The serious application of automatic control to open-hearth furnaces has just begun. The use of metering devices and of automatic control has made the prevention of leakage into and out of the checkers an absolute necessity. In the rolling mill, the demand for greater accuracy and closer tolerances has led to the use of pyrometers which measure the temperatures at all points in the length of the bar while it is being rolled. In furnaces, atmosphere control developments are noted, and complete automatic control has already been achieved. MFB(0)

Emphasizes Physical Properties in Specifying Steels. JOHN JOHNSTON (United States Steel Corp.). *Yearbook, American Iron & Steel Institute*, 1930, pages 63–93, includes discussion; *Iron Trade Review*, Vol. 86, May 15, 1930, pages 51–52; *Metal Stampings*, Vol. 3, June 1930, pages 517–518; *Rolling Mill Journal*, Vol. 4, May 1930, pages 215–217; *Foundry Trade Journal*, Vol. 43, July 31, 1930, page 76.

Abstract of a paper read before the American Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. VSP + MS(0)

Waldorf-Astoria Steel Is Found Well Preserved. F. H. FRANKLAND (American Institute of Steel Construction, Inc.). *Steel*, Vol. 87, Sept. 4, 1930, pages 50, 52.

Tabulates results of chemical analysis and physical tests, made by the National Tube Co., of 15 specimens of structural iron and steel obtained during the demolition of the old Waldorf-Astoria Hotel, New York. Eight samples were of Bessemer steel, 5 of open-hearth steel, and 2 of wrought-iron. Only evidence of corrosion found was in 4 small Z-bar columns in the court where roof leaks had permitted rain-water to enter the interior of the scagliola column in casement. This corrosion amounted to less than 1% of the net section. Tests indicate that there has been no serious deterioration of the metals during their almost 40 years of service in the building. MS(0)

Metallurgical Research Aids Industry. ROBERT E. BELT (Malleable Iron Research Institute). *Foundry*, Vol. 58, Aug. 15, 1930, pages 73–74.

From a paper presented at a meeting of the American Trade Association Executives. Most of the coöperative research work in iron and steel has been along metallurgical lines for improvement of quality of product. Discusses coöperative work done by a number of associations allied to the iron and steel industry. VSP(0)

Aeronautical Industry Favors Army-Navy Steel Standards. *Steel*, Vol. 87, July 31, 1930, pages 49–50.

Report of the sixth annual Army-Navy Standards Conference held at Wright Field, Dayton, Ohio, in May 1930. New specifications adopted were those for 18–8 Cr-Ni corrosion-resistant sheet or strip; Cr-V medium steel bars and billets, SAE 6135 analysis; Cr-V high-C steel bars, SAE 6150 analysis; and C steel spring wire. Composition and physical properties specified are tabulated. Specifications for mild-C seamless steel tubing were revised; provision was made for corrosion-resistant tie rods made of 18–8 Cr-Ni steel. SAE 3140 or SAE 6150 were adopted as optional steels for bolts, plain and castellated nuts and fillister head screws. Steel for propeller clamp ring was changed to SAE 6135. MS(0)

Coöperative Research in the Iron & Steel Industry. F. N. SPELLER (National Tube Company). *Preprint* for May 1931 meeting *American Iron & Steel Institute*, 23 pages.

Technical research leading to better understanding of materials and processes may be divided into competitive and non-competitive. The latter problems generally refer to the principles involved, benefit the whole industry, and can be most economically solved by coöperative effort. The organizations for coöperative research in Germany and England are discussed in some detail. Considerable governmental assistance is given in those countries. Some of the societies and groups engaged in coöperative research and some important research topics they are undertaking, are mentioned. Special attention is given to the work on physical chemistry of steel making, which for five years has been coöperatively supported by the U. S. Bureau of Mines, Carnegie Institute of Technology and the iron and steel industry, through an Advisory Board. The Bureau of Mines is withdrawing from the coöperative arrangement, and in order to facilitate the continuation of this project and the handling of other analogous projects in the future, Speller suggests the establishment of a Central Research Board which would plan for carrying out coöperative researches that might be suggested to it, if it approved of them as worth while. It would budget the work, and arrange for its financing, and select a suitable institution to carry on the project. As a first step, he suggests that the steel industry take over on a more permanent basis the work on physical chemistry of steel making. HWG(0)

Aluminum, Light Metals and Light Alloys. (L'Alluminio—i metalli leggeri e le loro leghe.) E. KOELLIKER & U. MAGNANI. Ulrico Hoepli, Milan, 1930. Half-cloth, 4 × 6¼ inches, 468 pages. Price 34 Lire.

This pocket-size book takes up the subject of aluminum from the point of view of the Italian economic situation. It deals quite briefly with the alloys of aluminum, their properties and uses, but more extensively with the preparation of the metal itself. In various places, the authors indicate a decided leaning toward the Haglund process.

Since the technical data which this book gives are far more completely covered in Edwards, Frary and Jeffries "The Aluminum Industry," American readers will find the present volume interesting chiefly for its exposition of the Italian point of view.—H. W. Gillett (0)-B-

On What Test Value Should Working Stress Be Based? H. F. MOORE. *Machine Design*, Vol. 3, Feb. 1931, pages 35–38.

In the design of a machine part, the working stress should not be considered from the viewpoint of one kind of strength, but from the viewpoint of each possible kind of failure. The author discusses, as criterion for design, ultimate tensile strength, elastic limit and yield point, fatigue limit, significance of ductility, creep limit, corrosion fatigue limit and impact. He points out that accelerated tests are not reliable and that the factor of safety of the design depends on the consideration of all stresses mentioned which may enter into a particular case. Ha(0)

Fundamental and Test Relations between Elasticity, Plasticity, Hardness and Toughness. (Begriffliche und prüfmethodische Beziehungen zwischen. Elastizität, Plastizität, Härte und Zähigkeit.) M. ROS & A. EICHINGER (Materialprüfungsanstalt, Switzerland). *First Communications of the New International Association for Testing Materials*. 1930, Group D, pages 72–80, 7 references.

Definitions of the properties mentioned. HWG(0)

PROPERTIES OF METALS (1)

Report on the Measurements of Total Radiation of Aluminum Surfaces. (Bericht über Messungen der Gesamtstrahlung von Aluminiumflächen.) E. SCHMIDT. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, June 1930, pages 91–96.

Tests made on aluminum with different kinds of surfaces were made to determine the radiation constants. With all metallic surfaces, the radiation constant increases with temperature; with aluminum oxide, however, it decreases, at least for thin films. The test results of the different materials are reproduced in diagrams. Ha(1)

The Properties of Transmission Wires of Electrolytic Copper, Bronze, Aluminum and Aldrey in Tensile Tests and Vibration Stress. (Untersuchungen über die Festigkeitseigenschaften von Freileitungsdrähten aus Elektrolytkupfer, Bronze, Aluminium und Aldrey bei Zerreissversuchen und bei Schwingungsbeanspruchung.) W. SCHWINNING & E. DORGERLOH. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, July-Aug. 1930, pages 99–130.

These tests were made to determine the elastic and plastic behavior of the above named materials at static load and vibration stresses. Comparisons of the microstructure and electric conductivity were also determined. The results are given in detail in a great number of diagrams and tables and micrographs which cannot be given briefly but must be seen in the original. Ha(1)

Molybdenum in 1930. *Climax Molybdenum Co.*, 104 pages.

Since this beautifully printed booklet consists entirely of reprints or extended abstracts of articles in technical literature appearing in 1930, and contains no direct advertising, it deserves mention here rather than merely under "Manufacturers' Literature." Some 50 articles are thus abstracted. The article by S. B. Ritchie, Watertown Arsenal (Army Ordnance July-August, 1930; see *Metals & Alloys*, Vol. 1, Nov. 1930, page 856) is reprinted in full. Other articles and abstracts deal with Mo plus W in high speed steels, with nitriding steels, special alloy steels, forgings, steel castings, cast iron, heat-resistant steels, with automobile and aircraft uses, and with methods of chemical analysis for Mo. HWG(1)

The Properties of Pure Nickel. *Metal Industry*, London, Vol. 38, Apr. 17, 1931, pages 407–408; original paper by Louis Jordon and Wm. H. Swanger, *Bureau of Standards Journal of Research*, Vol. 5, Dec. 1930, pages 1291–1307.

A number of physical properties of Ni analyzing 99.94% are given. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 27. PRK(1)

The Physical-Technological Properties of the Aluminium Oxide Insulation Layer. (Die physikalisch-technologischen Eigenschaften der Aluminiumoxyd-Isolationsschicht.) H. SCHMITT & L. LUX. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, June 1930, pages 75–81.

Aluminum oxide has proved to be a fairly good electrical insulator so that the V. A. W. and the Aluminiumspulen G. m. b. H. have developed a special electrolytic method to produce a firmly adhering oxide film on the wire. Tests with such wires up to 5 mm. are described. The breakdown voltage is almost linear to the thickness of the film. The ratio of the wire to the radius of bending is of great influence; the smaller this ratio, the lower the breakdown voltage. The resistance of the oxide film can be represented by $R = R_0 e^{\frac{1455}{T}}$, where R is the resistance in ohms at the absolute temperature T, and R_0 is the final value at $T = \infty$. In general, it can be said that with further progress, this oxide-covered material will find a wide field of application. Ha(1)

The Metallurgy of Some of the Rarer Metals. C. J. SMITHELLS. *Metal Industry*, London, Vol. 38, Mar. 27, 1931, pages 336–338.

Text of paper read before Coördinating Committee, Chamber of Commerce, Birmingham, March 17, 1931. Ductile Zr is produced by deposition on W filament at 1300° C. from ZrI_4 which is formed at 400° C. from Zr and I_2. Zr is obtained from Na reduction of potassium zirconium fluoride. Ta is obtained from Na reduction of potassium tantalofluoride. The metal is pressed into bars and sintered and then must be fused in vacuum. Mo is obtained by hydrogen reduction of the lower oxide at 900–1200° C. Mo swaged above 1000–1100° C. is brittle but when worked at lower temperatures becomes ductile. PRK(1)

Hafnium. PAUL M. TYLER. *Information Circular* 6457, *United States Bureau of Mines*, April 1931, 11 pages.

The following subjects are discussed: description and properties, occurrence (list of minerals), identification and analysis, geographic distribution, history, separation of zirconium and hafnium, preparation of hafnium and zirconium, preparation of pure hafnium salts, and production. Contains 20 footnote references. AHE(1)

The Relations of the Magnetic and Thermal Constants of Ferromagnetic Substances. J. R. ASHWORTH. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Oct. 1930, pages 681–694.

The ferromagnetic substances considered are iron, cobalt, nickel, Heusler's alloy and magnetite. RHP(1)

Directional Properties in Cold-Rolled and Annealed Copper. ARTHUR PHILLIPS & E. S. BUNN (Yale University). *Technical Publication* No. 413, *American Institute Mining & Metallurgical Engineers*, 1931, 18 pages.

To determine the effect of inclusions on the directional properties of Cu, 2 kinds of Cu were studied. One, an electrolytic Cu deoxidized with P, contained no inclusions, while the other, a tough-pitch Lake Cu, of course, contained oxide inclusions. Sheets of the 2 materials were reduced from 10.5 to 89.9% by cold rolling, and the tensile properties parallel, perpendicular and at 45° to the direction of rolling determined. Very little difference was found between the properties in these directions with any reduction. The sheets were annealed at various temperatures and tested in the 3 directions. With large reductions and high annealing temperatures pronounced directional properties occurred. The included oxide apparently had little effect on the directional properties. In order to avoid serious directional properties in Cu it is recommended that the reductions be limited to 50 or 60% and the final anneal to 500° or 600° C. 7 references. JLG(1)

The Atomic Weight of Vanadium. ARTHUR F. SCOTT & CLYDE R. JOHNSON. *Journal American Chemical Society*, Vol. 52, July 1930, pages 2638–2648.

The analysis of vanadyl trichloride yields as the atomic weight of vanadium 50.947. MEH(1)

A Simple Method for the Measurement of the Specific Heat of a Solid Body at Ordinary Temperatures. Application to Beryllium. (Méthode simple de mesure de la chaleur spécifique d'un corps solide à la température ordinaire. Application au glucinum.) P. VERNOTTE & A. JEUFROY. *Comptes Rendus de L'Académie des Sciences*, Vol. 192, Mar. 9, 1931, pages 612–614.

After discussing the various causes of error which can enter into determinations of the specific heat of solid bodies by the method of mixtures, the authors describe a method which largely eliminates these errors. This method has been applied to the determination of the specific heat of beryllium, which was found to have the value 0.397 cal.-g./deg. at 13° C. OWE(1)

Physical Properties of Zinc of Interest to Wire Galvanizers. W. G. IMHOFF. *Wire & Wire Products*, Vol. 5, Sept. 1931, pages 348–349, 361–364.

Discussion of the physical properties of zinc. GN)1)

NEW PRODUCTS

Welding Torch and Cutting Apparatus

The Linde Air Products Company, New York, has recently made two new additions to its line of Purox medium pressure apparatus for oxy-acetylene welding and cutting.

The new Purox No. 11 welding torch, which supersedes the Purox No. 10 torch, has a very wide welding range extending from the lightest sheet metal up to work as heavy as $^1/_2$-inch plate. In spite of this wide range the torch is very light in weight and has perfect balance. The tips are of one piece, hard-drawn copper construction and are so designed that the head angle can be easily adjusted as desired by the user. Tips Nos. 2, 4, 6, 8 and 10 are furnished as standard equipment.

The Purox No. 21 cutting attachment designed for use with the Purox No. 11 welding torch will cut metal up to 2 in. in thickness. It is furnished with one and two piece cutting tips. By means of this cutting attachment the welding torch can be easily and quickly converted into a cutting torch. This is claimed to be the lightest cutting attachment on the market, weighing only 1 lb. 8 oz.

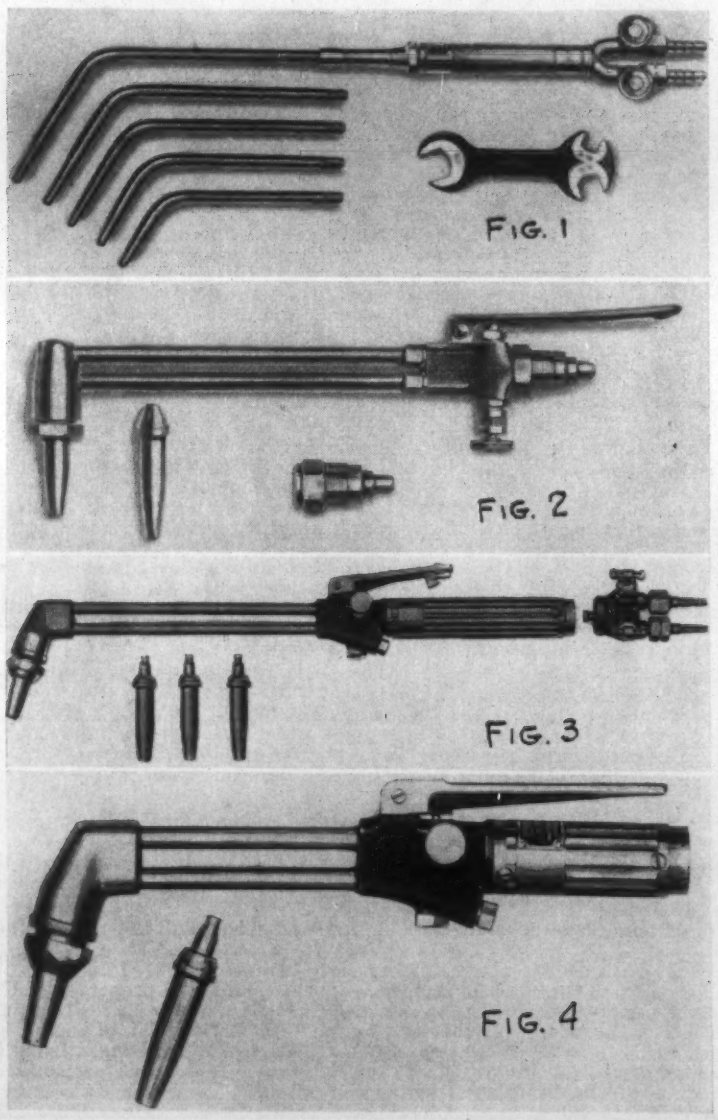

Fig. 1.—Purox No. 11 welding torch as supplied with five tips and wrench.
Fig. 2.—Purox No. 21 cutting attachment with two cutting tips and adaptor.
Fig. 3.—Prest-O-Weld Type C-105 cutting blowpipe.
Fig. 4.—Prest-O-Weld Type CW-105 cutting attachment.

An adaptor is also available which makes it possible to use the Purox No. 21 cutting attachment with the Purox No. 20 welding torch.

The new cutting apparatus includes the Prest-O-Weld Type C-105 cutting blowpipe and the Prest-O-Weld Type CW-105 cutting attachment.

These two types of cutting apparatus, together with the Types W-105 and W-106 welding blowpipes, can all be used interchangeably with the same detachable valve body. By means of the detachable valve body, the operator can change easily and quickly from a full size welding blowpipe to a smaller welding blowpipe, to a full size cutting blowpipe, or to a cutting attachment without detaching the hose or hose connections and without the use of a wrench.

The locking device for connecting the detachable valve body to any one of these blowpipe handles consists of a locking bolt and wedge-shaped locking screw. The locking screw is operated by turning a ring and draws the detachable valve body and blowpipe handle together making a gas-tight joint. The ring can also be used for hanging up the blowpipe when not in use.

Pressure forgings are used in the construction of the blowpipe head, cutting valve body and lever. The cutting oxygen tube is made of Ambrac, a special hard brass, to afford the necessary stiffness. The cutting nozzles have conical seats so designed that they will not become nicked or damaged if the nozzles should be accidentally dropped.

The blowpipe is light and well balanced, but at the same time it is of sturdy construction to withstand the hard usage to which cutting blowpipes may be subjected. It is furnished as standard with four cutting nozzles and a 75° angle head. If required, a 90° angle head can be furnished. Steel and wrought iron up to 12 inches in thickness may be easily cut with this blowpipe and metal of greater thickness can be cut by experienced operators.

The Prest-O-Weld Type CW-105 cutting attachment is of the single joint design and attaches directly to the valve body. It will readily cut metal up to 2 in. in thickness. Because of its small size, only 11 in. overall, it can be conveniently carried in the pocket of the operator when not in use. All the advantages of design and construction embodied in the full size Type C-105 cutting blowpipe are incorporated in this cutting attachment.

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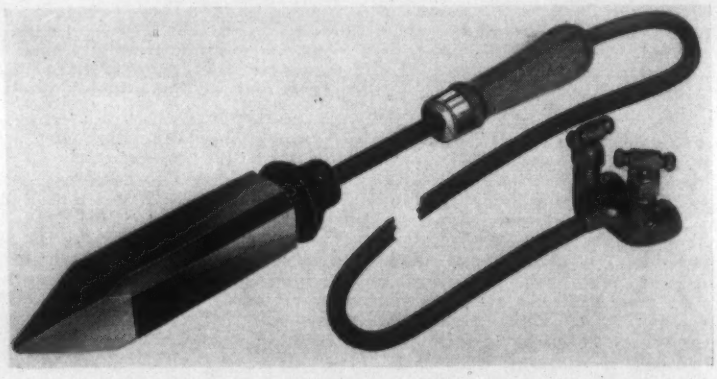
Gas-Heated Soldering Iron

A gas-heated soldering iron was recently introduced by the Reliance Specialties Manufacturing Company, New York.

Low gas consumption is claimed, with the 3-lb. head, the fuel required is only 4 or 5 cu. ft. of gas per hour, and with the 5-lb. head, 5 or 6 cu. ft. of gas per hour.



This iron is heated by either natural or artificial gas and low pressure air mixed by means of a needle valve, and passing through a flexible hose to the handle of the torch, making it very easy to operate.

Constant temperatures are increased or decreased at the option of the operator by regulation of the needle valve. The copper heads may be brought to a red heat within 3 to 5 minutes after lighting. A great deal of the filing and cleaning, dipping and retinning of the coppers is eliminated, inasmuch as the copper heads are not exposed to the open flame.

Coppers are available in sizes ranging from $^1/_2$ to 5 lbs. They also are made to specifications. The coppers are quickly interchangeable, being screwed onto the stainless steel tip. The "Torchiron" may be used as a torch as well as an iron, merely by removing the copper head.

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New Low Melting Point Brazing Alloy

Handy & Harman, New York, producers of sterling silver sheet metal and wire, silver solders and silver alloys in general, have applied for a patent on a new brazing alloy, "SIL-FOS." It contains a small percentage of silver and is described as flowing freely at 1300° F.

"SIL-FOS" promises to be worthy of consideration where higher melting point base-metal brazing or welding alloys cannot be used without danger of weakening, distorting or destroying the parts adjacent to the joint.

"SIL-FOS" is described as also possessing free-flowing properties, with deep and quick penetration. This characteristic is doubtless due to the silver in the alloy. In addition, it is pointed out that at 1400° F., the flow point of borax flux with which it is generally applied, there is 100° of superheat which increases the fluidity still further and aids penetration and alloying action.

Another feature claimed for "SIL-FOS" is that it requires less

(Continued on Page 162)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Directions for the Working of Silumin in the Foundry. (Richtlinien für die Verarbeitung des Silumins in der Giesserei.) DR. DORNAUF. *Aluminium, Hauszeitschrift der V. A. W. und Erftwerk*, Vol. 3, Jan.-Mar. 1931, pages 86–114.

An extremely instructive and exhaustive work illustrating the right and wrong way for preparing molds, castings, refining, temperature measurements. The mechanical-technological properties of silumin are described and illustrated in curves and diagrams and the third part is devoted to the physical-chemical properties of cast aluminum alloys with special reference to Al-Si alloys. All this information is in a handy form for ready use in practice. Ha(2)

Structure and Conductivity of Hard-Drawn Copper Wire. R. W. DRIER & C. T. EDDY. *Wire & Wire Products*, Vol. 5, Nov. 1930, pages 424–425, 436–437.

The article gives the results of investigations on the effect of the direction of drawing crystal orientation on the specific resistivity of hard-drawn copper wire. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 425, "Correlation of the Ultimate Structure of Hard-Drawn Copper Wire with Electrical Conductivity." GN(2)

Simple Aluminum Cast Alloys. (Einfache Aluminium-Gusslegierungen.) WILLI CLAUS. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk*, Vol. 3, Jan.-Mar. 1931, pages 54–66.

A short historical sketch is given of the development of pure aluminum and the alloyed aluminum materials. Two main alloys exist to-day: the American aluminum cast alloys which are binary copper-aluminum light metals (*without* zinc), usually 8% Cu and 92% Al, and the German aluminum cast alloys of a ternary type, Cu-Zn-Al, usually 2% Cu, 10% Zn and 88% Al. The latter form the basis for further alloys with Si, Mn, Ni, Mg and others. The density of the 2 main alloys is 3.1 for the German and 2.85 for the American. The diagrams of state, mechanical properties, instructions for melting, influence of pouring temperature on properties, disturbances by solid and gaseous impurities are described. The fields of application and possible economies are discussed and the path for further development shown. So far, special alloys for pistons, corrosion-proof and sea waterproof alloys have been developed. Ha(2)

Copper and Copper Alloys. W. H. BASSETT. *National Electric Light Association Bulletin*, Vol. 17, 1930, pages 275–278; *Mining & Metallurgy*, Vol. 11, Dec. 1930, pages 562–564.

A general discussion with special attention given to the newer alloys such as Cu-Be alloys and Everdur (Cu 96%, Si 3% and Mn 1%), and a Cu alloy containing 0.5–3.0% Cr. Comparison of the properties of Cu and Cu alloys and a comparison of Cu-Be alloys with Cu-Sn, and Cu-Cd alloys and corrosion tests on cast Everdur and cast 85–5–5–5 are tabulated. WHB+VSP(2)

A New Silicon-Zinc-Copper Alloy. E. VADERS. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 363–388.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. (2)

Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys. E. VOCE. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 331–361.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 899. (2)

The Composition of Manganese Amalgam and Manganese Silver Alloys in Relation to the Electrode Potential of Manganese. HARVEY D. ROYCE & LOUIS KAHLENBERG. *American Electrochemical Society, Preprint* 59–11, April 1931 meeting, 13 pages.

Four manganese-silver alloys were prepared from highly purified materials. Electrode potentials and replacing power of these alloys have been measured. The replacing power and potential of alloy D (31 atomic % Mn) were correlated with alloy structure by means of photomicrographs and thermal diagrams. None of the manganese-silver alloys yields electrode potential approaching to that of manganese amalgam: Manganese amalgam consists of solid Mn_2Hg_5 in equilibrium with a very dilute solution of manganese in mercury (0.0032% Mn). The behavior of manganese amalgam in contact with manganese salt solutions has been interpreted on the basis of these figures. A new compound of manganese and mercury, isolated from the dilute amalgam by the application of pressures exceeding 150,000 lbs./in.^{2} (10,500 kg./cm.^{2}) and having the formula MnHg, is described. MnHg constitutes the stable solid phase in the system Mn-Hg at temperatures between 86° and 100° C. Pressure-concentration curves are presented to justify the assumption that the solid phase obtained by pressure is MnHg contaminated with a small percentage of the liquid amalgam. (2)

Zinc and Its Alloys. (Le Zinc et ses alliages.) R. CAZAUD. *Aciers Speciaux, Métaux et Alliages* Vol. 6, Feb. 1931, pages 69–74.

Alloys commercially used are of three types: (1) 6% Sn, 3% Cu, 0.5% Al and 90.5% Zn. (2) 3% Cu, 4–5% Al, 93–92% Zn. (3) 3% Cu, 4% Al, 0.1 %Mg, 92.9% Zn. Binary Zn alloys discussed are: Zn-Al, Zn-Mg, Zn-Cd and Zn-Cu, giving equilibrium diagrams for Mg-Zn and Al-Zn. GTM(2)

A Research of Light Cast Alloys. B. OTANI. *Kinzoku no Kenkyu*, Japan, Jan. 1931, pages 43–52.

Silumin is not suitable for castings of complex form, as blow holes readily form. The author carried out number of tests of shrinkage, fluidity, mechanical and physical properties for great many alloys of modified Lautal and Silumin. The results showed that the following alloys were recommended for casting; Al-Cu-Si alloys containing 3.5% Cu, 4.5% Si and 0.1% Mg, or 6.5% Cu and 3.5% Si, and modified silumin containing 0.8% Cu, 8% Si, 8% Zn. KT(2)

Aluminium Alloy Manufacture. *Automobile Engineer*, Vol. 20, Oct. 1930, pages 357–364.

Group of alloys patented by Rolls-Royce, Ltd., and known as R. R. alloys have a composition of: copper 0.5–5%, nickel 0.2–1.5%, magnesium 0.1–5%, iron 0.6–1.5%, titanium up to 0.5%, silicon 0.2–5%, aluminum the remainder. From this composition, 4 grades are manufactured. Details of manufacture for each grade, testing, and X-ray examination of the parts are discussed. RHP(2)

Japanese Art Bronzes. (Ueber japanische Kunstbronzen.) EDMUND RICHARD THEWS. *Deutsche Goldschmeide-Zeitung*, Vol. 34, Apr. 25, 1931, pages 170–171.

Many of the Chinese or Japanese art bronzes contain appreciable quantities of Ag and Au. The bronzes were frequently colored by various methods, including etching. Some of the oldest alloys were probably made by direct reduction of the ores. The compositions of several solutions used for etching the bronzes are given. Remarkable effects were sometimes produced by casting from only partially molten metals. Contains 1 reference. JLG(2)

Brass, Bronze, and Other Copper Alloys for Spring Making. *Mainspring* (Wallace Barnes Co.), Vol. 4, Jan. 1931, pages 2–4.

Summarized properties of spring brass, phosphor bronze, monel metal, nickel silver and hardened copper. MFB(2)

The Austenite-pearlite Transformation and the Transition Constituents. ALBERT SAUVEUR (Harvard University). *Technical Publication* No. 412 *American Institute Mining & Metallurgical Engineers*, 1931, 6 pages.

It is just as impossible for austenite to transform to pearlite without passing through the intermediate constituents, martensite, troostite and sorbite, as it is for water to freeze without passing through the stage water and ice. The exact mechanism of the austenite-pearlite transformation is discussed. 1 reference. JLG(2)

PROPERTIES OF FERROUS ALLOYS (3)

Rise of the Break in Tensile-Strength Curve of Metals due to Strain and Aging. (Sur le relèvement du palier de la courbe de traction des metaux par traction et vieillisement.) J. GALIBOURG. *Comptes Rendus*, Vol. 188, Apr. 8, 1929, pages 992–995.

Curves are given representing variation of rise for extra-soft steel as function of time. See *Metals & Alloys*, Vol. 1, Nov. 1929, page 241. (3)

Gray Iron Possesses Valuable Engineering Properties. Part VIII. *Foundry*, Vol. 58, Sept. 1, 1930, pages 94–97, 101.

Discusses results of various investigators on the determination of properties of gray iron and their interpretation. The shear tests for cast iron have been proposed. The relation of shear to tensile test indicates a nearly constant relationship. Shear tests should run consistently higher than tensile tests. In chill or in high phosphorous irons this relationship does not apply. Tabulates results. VSP(3)

Gray Iron Possesses Valuable Engineering Properties. *Foundry*, Vol. 58, Oct. 1, 1930, pages 83–85; Nov. 1, 1930, pages 86–88, 118; Dec. 1, pages 76–79, 103–104.

Gray iron must possess resistance to shock and vibration as well as sufficient static strength. High strength Fe possesses greater impact resistance than the weaker Fe. The Izod and Charpy impact testing machines are used. The main reason that impact value of gray Fe is low, is the presence of weak graphite flakes. This influence is modified by the nature of the metallic matrix which is composed of pearlite, ferrite and steadite. Impact value of cast Fe is proportional to the work under the stress-strain diagram. For high impact resistance lowering the C and P is advantageous. Fatigue tests show: (1) Endurance limit of gray Fe is about $^1/_2$ the ultimate tensile strength when test piece is protected from external vibrations. (2) Values for endurance limit are not reduced greatly up to 800° F.; above 1250° F., endurance limit is as high as tensile strength. (3) Tests on range stress indicate that endurance limit from stresses from zero to a maximum tension are about $^1/_2$ times the limit for completely reversed flexual stress. Brinell test is the most common hardness test applied to gray Fe. Fe composed of all ferrite and graphite is likely to have a Brinell number of 100. Such Fe is low in tensile strength. Pearlite, the eutectoid of ferrite and cementite, offers resistance to indentation and the Brinell of pearlitic Fe is around 200. Such Fe possesses good strength and wearing properties. Hardness may be increased by changing the form of the combined C. Relation of Brinell to other physical properties of gray Fe has been suggested by Portevin, using the formula $K_z = 0.2H - 13$, where H = Brinell number and K_z = tensile strength expressed in kg./mm.^{2} Schuez proposed $K_z = \frac{H - 40}{6}$. Brinell test is also useful as an indicator of uniformity of hardness and shows presence of spongy and unsound areas. Specific gravity of commercial high carbon Fe at room temperature varies from about 6.95 for open grained high carbon Fe to 7.35 for closed grained low carbon metals. The specific gravity of the ordinary structural components of gray Fe at 15° to 20° C. are: ferrite, 7.85–7.88; graphite, 2.26; cementite, 7.66; pearlite, 7.74; iron phosphide 6.74; steadite, (about) 7.14; iron sulphide, 5.02; manganese sulphide, 3.99. Highest strength values are found in Fe free from microscopic shrinkage. Metals' expansions and contractions are due to: change in volume with change in temperature, structure of metal constant; change in volume due to change in state and change in volume due to change in constitution. Gray Fe contraction may be liquid or solid. Discusses results of other investigators on the contraction of gray Fe. When liquid Fe changes to solid there is a marked contraction occurring over a short range of temperature. More shrinkage defects, drawholes and spongy spots are due to illogical design than to all other causes together. Risers are used to feed castings. Proper gating is essential to production of sound castings. VSP(3)

"Tungum Metal." *Metal Industry*, London, Vol. 38, Apr. 3, 1931, page 365.

"Tungum" is a new anti-corrosive alloy which is strong, very ductile and obtainable in castings, tubes, sheet, wire. A table lists the corrosion resistance to numerous acids. PRK(3)

Arbed-super Cobalt High Speed Steel. (Acier extra-rapid Arbed-super Cobalt.) *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Feb. 1931, page 80.

A new high speed steel of the chemical composition: C, 0.78–0.80%; Cr, 4%; W, 18%; V, 1.50%; Co, 18%; Mo, 0.50%, has been developed which performs better than any high speed steel. It is used for cutting cast iron, hard steels and 12–14% Mn steel. GTM(3)

Effect of Rolling Reduction, Finishing Temperature and Heat Treatment on the Physical Properties, Aging and Structure of Thick Sheets. (Einfluss des Walzgrades, der Walzendtemperatur und der Wärmebehandlung auf die mechanischen Eigenschaften, die Alterungsempfindlichkeit und das Gefüge von Grobblechen.) F. KÖRBER & K. WALLMANN. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, 1930, No. 13, Report 156, pages 171–191.

Four different steels with varying C, Si and Mn content were rolled to sheets, 25, 20 and 15 mm. thick, with temperatures of 900°, 800° and 700° C. at the finish and tested after normal air cooling, cooling in a pile, annealing below and above the upper critical point and subsequent furnace or air cooling. The same 4 steels were also tempered either by quenching in hot water or by quenching and drawing at 600° and 400° C., respectively. The tensile strength, yield point, 0.2 limit, limit of elasticity, elongation, reduction of area, notch toughness and sensitivity toward aging were tested. Low rolling finishing temperatures bring about a fine grain, increase the limit of elasticity and yield point without essentially affecting the tensile strength. Low finishing temperatures, however, greatly impair the notch toughness of low carbon steel. The notch toughness of higher carbon steels is either not affected or, in part, improved by a lower finishing temperature. Annealing does not affect elongation and reduction of area to a large extent. Retarded cooling after annealing brings about poor physical properties and coarse grain. Thin sheets show aging effects to a smaller degree than thick sheets. GN (3)

Progress in Steel Manufacture. L. K. EVERITT. *Edgar Allen News*, Vol. 9, Sept. 1930, pages 698–700.

Properties and uses and 2 tables summarizing the analysis, heat treatment and tensile tests of a Ni-Cr and a Ni-Cr-Mo steel. ACW(3)

Alloys of Iron, Nickel and Chromium. M. A. GROSSMAN (Central Alloy Steel Corporation). *First Communications of the New International Association for the Testing of Materials*. Group A, Zurich, 1930, pages 97–103.

General description of constitution, properties and uses of these alloys. HWG(3)

Requirements, Properties and Testing of Steel Wire for the Manufacture of Bolts. (Auforderungen, Eigenschaften und Prüfung von Stahlstauchdrähten für die Schraubenfertigung.) WILLY AUMANN. *Stahl und Eisen*, Vol. 50, Nov. 13, 1930, pages 1611–1616.

The paper deals with the relations between the processing of bolts and the steel quality, the failures occurring and the difficulties due to the bolt making process, itself. Reference is made to the technological properties of the wire used as well as the composition. Finally, rules are given to standardize the testing of the wire as well as investigations on the processing of bolts. GN(3)

than the usual amount of flux because of the deoxidizing effect of the phosphorus in the alloy. This would seem to be an important advantage and should tend to reduce the cost of cleaning and finishing after joints have been made. Under certain conditions, satisfactory copper to copper joints can be made without using any flux.

As to strength, the makers report, for example, that lap joints of copper sheets show tensile strength of approximately 30,000 lbs. per square inch. They also claim that "SIL-FOS" can be used in many cases for joining brass, bronze, nickel, nickel-silver, extruded brass and bronze, monel metal, and other metals and alloys fusing above 1300° F.

While containing silver, "SIL-FOS" is not classed as a silver solder.

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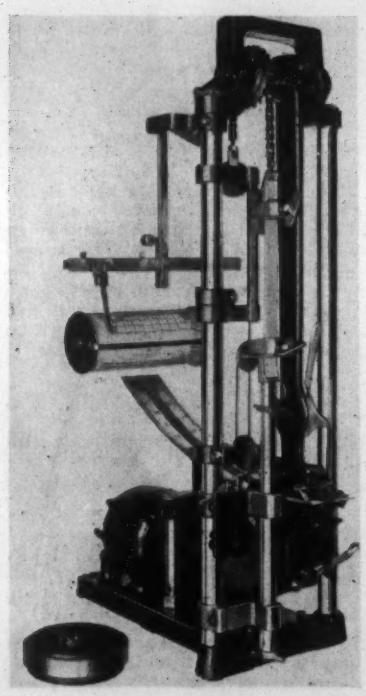
Tensile Strength Tester

For determining the tensile properties of metal sheets and wires the new model Amthor Tensile Machine, developed by the Amthor Testing Instrument Co., Inc., is claimed to embody many new improvements in design, operation and control, and provides a complete and exact test evaluation in a comparison graphic record.

It is what is known as a vertical, pendulum type, motor driven machine. The pulling force is applied to the pulling clamp through the test specimen and to the upper clamp, which is directly connected to the pendulum or indicator arm. Pawls are provided to hold the indicator arm at the exact breaking point on the graduated scales when the specimen breaks.



Operation of this model has been even further simplified and is controlled throughout the test. Once the control lever is set, the tester operates by itself and requires no further care. When the specimen breaks, operation automatically ceases and the tensile strength is pointed out, locked on the graduated scales, of which there are two; one scale for the high capacity and the other for the low. By having two separate capacity ranges and with a separate graduated scale covering each, it is possible to use the tester for testing the heavier specimens, without affecting its accuracy or sensitivity for testing the much lighter specimens. In addition, much finer and closer readings can be obtained.

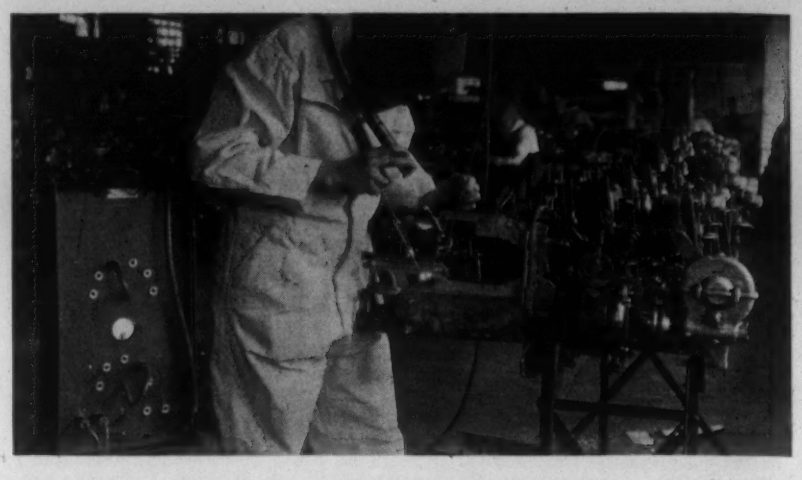
The recording unit operates automatically in conjunction with the indicator, and produces as complete and exact an evaluation of the metal's physical properties as it is possible to obtain with this type of test. The chart not only shows the exact tensile strength, elongation and the proportion of elongation to the increasing load, but also the entire action of the metal under test. It plots a curve showing the action of the specimen from the instant of first tension under load to the last minutest elongation when the molecules have separated after the yield point. To further simplify the reading the chart is quadrilaterally subdivided. Several tests can be made on the same chart, thereby allowing a minute comparison of all tests to be made together. If desired, the tester can be had with elongation scale instead of recording unit.

A $^1/_6$ H. P. constant speed motor is permanently mounted directly on the base of the tester and operates the pulling clamp through the variable speed control unit. By means of this unit, these pulling speeds can be varied according to the specific metal being tested. The whole tester stands only about 3 feet high, and is compactly designed. The important moving mechanism is encased in a special dust-proof metal housing into which no particles of the test specimens can enter.

◆ ◆ ◆

Electric Welding Torch

An electric welding torch that operates from an ordinary 110 v. or 220 v. A. C. lighting circuit has been perfected and now is being manufactured by the Warner Engineering Company, Pomona, Cal. By means of transformer coilation and a magnetic



effect a smooth, steady flame is produced between carbon electrodes.

Models operating on 110 volts will weld virtually all metals including aluminum and can also be used for hard soldering with German silver and silver solder. The 220 v. models are for heavier work and a special 220 v. welder is made that in addition the flame feature can be used for carbon and metallic arc welding.

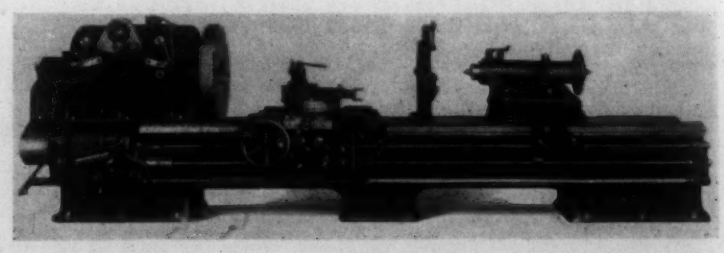
The flame produced between the carbon electrodes is extremely flexible in use and is non-oxidizing. Heat control is obtained by using different switch taps in the transformer box and by varying the distance between the electrodes. Flame volume may be regulated by different sized electrodes.

Ease of portability of the device and the convenience of power always available to any electric socket, make the welder adaptable to almost any kind of work.

◆ ◆ ◆

New 30″ and 36″ Heavy Duty Engine Lathes

Some of the most interesting features claimed for Tritro heavy duty engine lathes are: direct reading 16 speed control; the totally enclosed anti-friction self-oiling gear box; anti-friction end gearing and the anti-friction centrally oiled apron. One of the biggest advances in engine lathe design is found in the method of guiding and holding the carriage to the bed. The carriage is guided on the bed by large vees front and back and a wide flat bearing is placed under the bridge where the tool pressure comes. The gibs are located in the center of the bed on square guides which not only keep the carriage from lifting under the heaviest cuts, but also strengthens the bridge considerably. The bed is a four wall construction, cast from 0.50 to 0.60 carbon, 1% nickel steel.



The headstock is full herringbone gear design and operates on anti-friction bearings. All bearings are adjustable for take-up from outside the headstock without removing the cover. A positive force feed lubrication system assures a constant flow of clean, fresh lubricant to all bearings and moving parts in the headstock.

The spindle and all drive shafts are made from alloy steel forgings. The spindle is of exceptionally large diameter. The positive jawed clutch together with the herringbone geared headstock makes possible sudden spindle speed changes without danger of damaging of the work, tool or machine.

The gear box is dust proof and chip proof. It is lubricated by a central oiling system.

The heavy double walled apron is equipped with anti-friction bearings. The non-revolving snap lever apron controls, it is claimed, can be thrown out or in with a flip of the finger yet they will not slip out of engagement under the heaviest loads. A lever on the aprons provides a reverse to all feeds without reversing the spindle.

These lathes are manufactured by the Sidney Machine Tool Company and distributed by Joseph T. Ryerson & Son, Inc., Chicago.

(Continued on Page 170)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Mechanism of the Corrosion of Duralumin by Sea Water. E. HERZOG & G. CHAUDRON. *American Metal Market*, Vol. 38, Feb. 5, 1931, page 5.

Abstract of a paper in *Comptes Rendus*, Vol. 190, 1930, pages 1189–1190. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 904. WHB(4)

Scaling of Steel at Forging Temperatures. W. E. JOMINY & D. W MURPHY. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1423–1425.

From paper read before the American Society for Steel Treating. MS(4)

The Effect of Supports on the Catalytic Activity of Nickel. CHARLES R. GLASS & LOUIS KAHLENBERG. *American Electrochemical Society, Preprint* 59–13, April 1931 meeting, 18 pages.

Those support materials which inhibit the catalytic activity of Pt and Pd have been found to affect Ni similarly. The behavior of the supports with relation to the hydrogenation of cotton-seed oil by Ni can be classified as follows: Reducible heavy metal oxides completely inhibit the activity of Ni. The salts of those metals that decompose on heating in a stream of hydrogen, completely inhibit activity. The salts in every case have been found to yield more active supports than the corresponding oxides. The more inert the support becomes toward Ni, the greater is its tendency to enhance activity. The less inert the support becomes toward Ni, the greater is its tendency to retard activity. The oxides of Si, Al, Cr, Mn, Ti, Ce, U and Mg, and the phosphates and borates of Al, Cr, Mn, Ce, U, Mg, Ca, Sr, Ba and Li proved very beneficial as supports for nickel in hydrogenation. (4)

Method for Checking the Local Element Theory of Corrosion. (Verfahren zur Prüfung der Lokalelmenttheorie der Korrosion.) W. GUERTLER & B. BLUM. *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 118–119.

Summary of a paper published in *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 152, Apr. 1931, pages 197–234. EF(4)

Corrosion in Tanks and Tankers. J. FOSTER KING & J. L. ADAM. *Advance Copy, North-East Coast Institution of Engineers and Shipbuilders*, Apr. 17, 1931, 8 pages.

The paper describes forms of corrosion and erosion to be expected in tanks used for the transportation in bulk of liquid cargoes under varying conditions of service. Attention is also drawn to factors which affect the rate or extent of corrosion, quality of material, protective coatings, upkeep, etc. Particulars are given of the different corrosive effects of water, heavy oils and spirit upon tank structures and details of actual cases are cited. Attention is drawn to the association of durability and cost of maintenance, with necessary freight charges and cost to consumers. The paper as a whole relates observed facts with probable causes and cures in the hope that discussion will promote collaboration between metallurgists, chemists, builders and owners in efforts to promote a better knowledge of the causes and effects of corrosion and an improvement in the economics of the transportation of fluids in bulk. (4)

A Note on the Tarnishing of Chromium-Plated Brass. W. M. PHILLIPS. *American Electrochemical Society, Preprint* 59–36, April 1931 meeting, 2 pages.

In the St. Louis district chromium-plated articles appear to have tarnished. Investigation shows that where no nickel or insufficient nickel is first plated over brass or copper articles, this type of failure can occur. (4)

The Open-Air Corrosion of Copper. II. The Mineralogical Relationships of Corrosion Products. W. H. J. VERNON & L. WHITBY. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 389–408.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 843. (4)

Heat Treatment of Chromium Deposits to Increase Their Resistance to Corrosion. R. J. WIRSHING (General Motors Corp.). *Metal Industry*, N. Y., Vol. 28, Dec. 1930, page 557; *Metal Cleaning & Finishing*, Vol. 2, Nov. 2, 1930, pages 959–960.

From a paper presented before the American Electrochemical Society at Detroit, Sept. 25–27, 1930. Heat treatment seems to offer a means of increasing the resistance of Cr deposits to many forms of corrosion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 902. MS+VSP(4)

Corrosion-Resisting Steel. *Power*, Vol. 70, Nov. 19, 1929, page 808.

A corrosion-resistant steel intended to resist the action of hot weak solutions of sulphuric acid is being produced under the name "Durimet" by the Duriron Co., Inc., Dayton, Ohio. Three varieties are available: Grade A containing 25% Ni, 5% Si, traces of Cr and 0.25% C; Grade B containing 35% Ni, 5% Si, 12% Cr and 0.25% C; Grade D containing 15% Ni, 3% Si, 2.5% Cr and 0.60% C. The A and B grades can be furnished in the form of hot or cold-rolled bars, sheets and plates ground and polished shafting, wire, rivets, bolts and nuts and castings. The D grade is furnished only in the form of castings. The B grade shows good resistance to hot glacial acetic acid and can be used for ventilating fans and ducts, towers and similar equipment handling entrained sulphuric acid and laboratory fumes. The D grade has approximately the same acid-resisting qualities as the A grade. VVK(4)

The Use of Aluminum for Oil Lease Tanks. Part 1—Field Tests. LUDWIG SCHMIDT, JOHN M. DEVINE & C. J. WILHELM. *Report of Investigations* 3066, *United States Bureau of Mines*, April, 1931, 17 pages.

Tests are described which indicate that under certain operating conditions aluminum has promising possibilities as a material for the construction of lease tankage because of its resistance to the corrosive action of hydrogen sulphide gas. The use of aluminum steam coils in flow tanks or stock tanks where the coils come in contact with salt water is not practical. It is possible that other forms or alloys of aluminum may be developed that will be successful in resisting high temperature salt water corrosion. Certain fittings of No. 43 alloy resisted such corrosion. The aluminum tank plate used did not prove highly resistant to the corrosive action of concentrated brines as was shown by deep etching in those areas of the side sheets which had been subjected to the action of salt water for an extended period. In places where aluminum is used in conjunction with steel, extreme care must be taken that no electrolyte is present. 7 references. AHE(4)

Sea Water Resistance of Various Anti-Corrosion Coatings on Iron and Light Alloys. E. K. O. SCHMIDT. *Automotive Abstracts*, Vol. 9, May 1931, page 157. Original in *Zeitschrift Flugtechnik und Motorluftschiffahrt*, March 14, 1931, pages 141–147; *Korrosion und Metallschutz*, Vol. 7, Apr. 1931, pages 111–112.

Practical observations on corrosion prevention in sea planes. For steel, cadmium plating is recommended, a Cd-Zn mixture is less effective than Cd Zn has only temporary value. The 18–8 type of steel is practically uncorroded. Cadmium plating on duralumin and Lautal generally gave good results, but it should not be used on electron. Rubber coatings seldom gave satisfaction. EF+HWG(4)

The Influence of Sodium Chloride Solutions of Various Concentrations upon the Course of Corrosion Attack in the Alternating Submersion Test. (Einfluss von Kochsalzlösungen verschiedener Konzentration auf den Verlauf des Korrosionsangriffs im Wechseltauchversuch.) E. K. O. SCHMIDT. *Korrosion und Metallschutz*, Vol. 6, Nov. 1930, pages 250–255.

Alternating submersion tests were performed on 0.5 mm. Lautal samples in salt solutions of 3, 5, 10 and 20% NaCl solutions and the corrosion attack investigated by visual and micro-examination and by determination of the loss in physical properties. Regarding the concentration of the corrosion medium, differences were only found in the beginning of the tests. At later stages the concentration does not matter. The loss in physical properties during the corrosion attack, however, is essentially smaller in the 1% NaCl solution. In conclusion, the author tries to interpret the phenomenon of corrosion attack. EF(4)

ILLIUM is not a "new" alloy. It has been in successful use more than 15 years, sometimes in acids—sulphuric, nitric, acetic, phosphoric, *mixed* nitric and sulphuric, etc.—sometimes in alkalies.

While not a cure-all for every ill, ILLIUM *is* a complete, permanent and moderate priced answer to many of the corrosion troubles commonly encountered.

Dense, close grained, with considerable tensile strength, ILLIUM withstands heat, torque, impact and wear. It is especially recommended for pump and valve parts, agitators, or pieces requiring accurate machining.

UNIVERSAL
CORROSION-RESISTANT
ALLOY
sold in form of castings, easily machined, takes high polish

ILLIUM castings, rough or finished are made to your specifications in our modern foundry. Our engineers will quote from your patterns or drawings, or will work with you in designing ILLIUM parts for your product.

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DIVISION OF C. F. BURGESS LABORATORIES INC.
MOLINE, ILLINOIS

Outdoor Corrosion of Protective Zinc Coatings. C. L. Hippensteel, C. W. Borgmann & F. F. Farnsworth. *Proceedings American Society for Testing Materials*, Vol. 30, 1930, Pt. 2, pages 456–472.

Sherardized and hot-dipped zinc coated steel specimens exposed to the outdoor atmosphere in New York City lost weight at the same rate. The attack upon the zinc and upon the iron-zinc alloy layer went on at the same rate. Simulation of additional rainfall by water-spraying the outdoor specimens speeded up the attack without affecting relative performance of the coatings. This gives more reliable information than does any accelerated laboratory test. In discussion, it was brought out that most laboratory tests give erroneous indications in respect to the rate of corrosion of the iron-zinc alloy layer. HWG(4)

Contribution to the Evans Theory. (Beitrag zur Evansschen Belüftungstheorie.) E. Herzog & G. Chaudron. *Korrosion und Metallschutz*, Vol. 7, Jan. 1931, page 1; E. Maass & E. Liebreich, pages 2–3.

Continuation of the controversy on the value of the drop corrosion test and the interpretation given by Evans. See *Metals & Alloys*, Vol. 2, Mar. 1931, page 84. EF(4)

Use of Aluminum in Chemistry. (Die Verwendung des Aluminiums in der Chemie.) P. Drossbach. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 39–44.

The property of aluminum, in solutions at anodic polarization, to develop a very thin film which protects it against corrosion makes it particularly adaptable for apparatus in chemistry. This film has an extremely great resistance to electric currents which accounts for the great resistance of aluminum to corrosion. The theory of corrosion by local elements is briefly explained. 3 pages of test results with inorganic solutions are given, showing the loss of weight of aluminum. By reference to these tables, it can be ascertained at once whether aluminum can be used in contact with a certain solution. Ha(4)

On the Corrosion of Lead Pipes. (Ueber die Korrosion in Bleirohren.) W. Obst. *Korrosion und Metallschutz*, Vol. 7, Jan. 1931, pages 12–13.

Author reviews the corrosion of lead pipes starting from both inside and outside. The insulation in moist brick work and in earth is stressed and the various possibilities outlined. EF(4)

Weather-Resistant Steels—Especially Copper Steels. (Witterungsbeständige Stähle mit besonderer Berücksichtigung der Gekupferten Stähle.) W. Mattheis. *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns*, Vol. 1, Sept. 1930, pages 2–7, 13 references.

Résumé of published literature favorable to the use of copper steel. Emphasis is placed on the adherent nature of the rust formed upon it. No new data are given. HWG(4)

Stress and Corrosion. D. J. McAdam, Jr. (Naval Expt. Sta.). *3d. International Congress for Applied Mechanics*, Stockholm meeting, August 1930, Separate pamphlet, 25 pages, 13 figures.

General summary of McAdam's work on corrosion-fatigue, presented in 15 previous papers. Boiler corrosion under steady stress and under repeated stress, is considered in some detail. HWG(4)

Corrosion of Iron by Carbon Tetrachloride. (Contribution a la connaissance de la corrosion du fer pa le tetrachlorure de carbone.) J. Milbauer. *Collection Czechoslovak Chemical Communications*, Vol. 3, Jan.-Feb. 1931, pages 73–75.

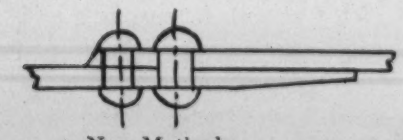
Iron is corroded by CCl_4 in presence of ethyl alcohol and water. A test made, consisted in boiling iron for 1 hour in a mixture of CCl_4, ethyl alcohol, and water. The results obtained were:

CCl_4	C_2H_5OH	H_2O	Fe dissolved
80%	11%	9%	0.24 grams
50	41	9	0.93
30	60	10	0.9
80	18	2	1.04
45	5	50	0.13
90	9.1	0.9	0.63
70	27.3	2.7	1.81
70	20	10	0.74
70	10	20	0.16
100	0	0	0
0	100	0	0

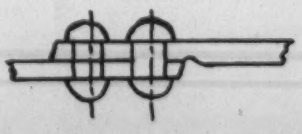
Maximum corrosion is obtained with a mixture of 70% CCl_4, 27.3% ethyl alcohol and 2.7% water. The presence of alcohol favors the corrosion of Fe by CCl_4. GTM(4)

Boiler and Tender Corrosion and Pitting. *Boiler Maker*, Vol. 30, Nov. 1930, pages 313–321.

Condensed report of a committee (O. H. Kurlfinke and C. W. Buffington) of the Master Boiler Makers presented at the May 1930 convention. Corrosion, which is a chemical action set up between the acids in the water and the metal, varies quite materially, depending upon the composition of the metal in the sheets and the nature of the acids in the water, but can to a great extent be overcome if the water can be kept moving. Pitting, which is due to dissolved gases, occurs when the boiler is merely warm to a much greater extent than when it is hot and in service. Preventive measures for both corrosion and pitting lie through the medium of keeping the water moving. The size of the modern locomotive boiler has contributed to corrosion and pitting because of the increased amount of water evaporated compared to years past, and because of the difficulty in stimulating circulation of the water due to the increased length of the boiler. Various methods and devices for assisting circulation of the water such as the arch tube, the Nicholson thermic siphon, and the Martin circulator are discussed. Continuous and rapid circulation of water through the barrel of the boiler means an



New Method



Old Method

equalization of the temperature of the water surrounding the tubes, greatly increasing their life and utility and aiding in preventing pitting and corrosion of boiler shell and firebox sheets. Removal of dissolved oxygen from the boiler water by various devices has also cut down corrosion. Examples are given. The committee also suggested an improved design of girth seam to eliminate grooving of the shell plate at the inside calking edge. Care should be taken of the materials before they are applied to the boiler in order to prevent rust and atmospheric corrosion from starting and roughening the surface of the metal. Various commercial compounds such as "Oxaline" can be used for this purpose. Cleaning the boiler with 40 to 80 lbs. of soda ash before firing or spraying with 3 quarts of cement to 1 gallon of water when the boiler is in the shop for repairs is effective. In the corrosion of tenders paints have been unsatisfactory. Coating the inside with cement has produced good results. A method for calculating the factor of safety of a pitted shell plate consisting of drawing a profile map of the deteriorated portion and then calculating stresses from the thicknesses of the plate is described. VVK(4)

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A New Method of Corrosion Protection of Metal Tubes. (Ein neues Verfahren für den äusseren Schutz von Metallrohren gegen Korrosion.) A. Rocca. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 207.

Refers to an externally applied protection by a mixture of concrete and asbestos on a layer of tar or bitumen. Paper was presented before the International Congress of Mining, Metallurgy and Applied Geology, Liege, June 1930. See also "Protection against Corrosion of Pipes," *Metals & Alloys*, Vol. 2, Jan. 1931, page 2. EF(4)

Evolution of a New Chemical Industry. Lee H. Clark (The Sharples Solvents Corporation). *Chemical & Metallurgical Engineering*, Vol. 38, Apr. 1931, pages 206–210.

Mention is made of the materials of construction used and of the corrosion problems met with in the synthesis of amyl chlorides from pentane and chlorine gas. PRK(4)

Thermal Requirements and Operating Characteristics of the Urea Autoclave. K. G. Clark & V. L. Gaddy (Bureau of Chemistry and Soils, Washington, D. C.). *Industrial & Engineering Chemistry*, Vol. 22, Oct. 1930, pages 1084–1087.

Data are given for the corrosion resistance of a number of metals under operating conditions. In this process of direct synthesis of urea from liquid ammonia and liquid carbon dioxide, the order of corrosion resistance by the metals is Cr, Ta, duriron, Ni, illium G, rezistal 3, Pb, Al, enduro KA, Sn, Zn. MEH(4)

The Influence of Impurities in Soft Lead on its Behavior Toward Acids. (Einfluss von geringen Beimengungen auf das Verhalten von Weichblei gegen Säuren.) Arthur Burkhardt. *Metallwirtschaft*, Vol. 10, Mar. 6, 1931, pages 181–187.

Contains 3 references. 41 commercial grades and alloys of Pb containing small percentages of Cu, Ni, Bi, Sn, Sb, Te, Zn, Cd, Ag, Tl, Fe, Hg or Li, or combinations of these were tested for corrosion resistance against various strengths of H_2SO_4 and HCl at 20°, 90°, 130°, 170° and 220° C. Tensile tests are not a suitable measure as the strength drops in proportion to the reduction in cross section of the test bar. Loss of weight was determined instead. 70% H_2SO_4 at 170° attacks commercial Pb containing Bi, Zn or Ag most, then those containing little or no Cu, and those containing Ni or Cu the least. Cu can compensate for the bad influence of Bi. At 90° Sn, Sb and Ag are no worse than Cu alloys and at 20° there is very little difference between any of the grades. With 98% H_2SO_4 similar results were obtained. Fe, Sb, Sn, Te, Cu and Ni retard corrosion of Pb in H_2SO_4, Tl and Hg have no effect, Li, Ag, Zn, Cd and Bi increase corrosion. Tests were also made in 10% and 20% HCl and in moist Cl_2 at 20° and 90°. In HCl the Cu, Ni and Te containing brands are attacked most and the purest grades least. In 20% HCl the attack is greater than in H_2SO_4, but in 10% HCl it is slight, in moist Cl_2 a little greater. Attempts to obtain greater resistance to HCl by alloying failed. No theory for the effect of impurities on the corrosion of Pb has been worked out, it must be determined empirically. CEM(4)

New Type of Tank Overcomes Corrosion in Aluminum Welds. A. Eyles. *Iron Age*, Vol. 126, Dec. 25, 1930, page 1934.

Observation of Al tanks shows that corrosion usually begins at the welded joints or seams. Tanks for storage of oil and gasoline in aircraft are made from thin tinned steel sheet, riveted and soldered at the joints. New type of tank is designed so that the complete internal surface of tank can be burnished. The tanks were tested far beyond requirements. These tanks are built by Vickery, Ltd., Weybridge, England. VSP(4)

Experiments with Aluminum in Solutions of Soda and Soap. (Versuche mit Aluminium in Soda- und Seifenlösung.) H. Bohner. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 48–49.

The behavior of aluminum in soap and soda solution in the presence of heavy metals is investigated and it is stated that the electrolytic potential law is not generally valid for soda solutions. The addition of sodium silicate entirely prevents the attack of Al at room temperature as well as at 50°–60° C., whether or not Cu, brass or other heavy metals are present in the solution. Ha(4)

Molecular Ray Experiments. The Chemical Activity of Molecular and Atomic Oxygen. Worth H. Rodebush & W. A. Nichols, Jr. *Journal American Chemical Society*, Vol. 52, Oct. 1930, pages 3864–3868.

An exhaustive search failed to discover any surface (metallic Ag, Cu and Na) with which a beam of oxygen molecules will react to give a visible image At slightly elevated temperatures of the metals, a film of oxide is readily visible. Results of tests with atomic oxygen and a reducing action of atomic oxygen are discussed. MEH(4)

Heat Resistivity of Aluminum Steels and Aluminum Coated Iron. (Hitzebeständigkeit von Aluminiumstählen und von Aluminiumüberzügen auf Eisen.) A. Hauttmann. *Stahl und Eisen*, Vol. 51, Jan. 15, 1931, pages 65–67.

Steels with varying contents of Al were heated in air at 1000° C. in an electric furnace. The increase of weight after heating for 48 hrs. at that temperature is taken as an indication of the heat resistivity. The table below gives some of the results, indicating that there is a sudden increase of heat resistivity around 9% Al.

Sample No.	% Aluminum	Increase of Weight g./m.²/h.
1	0.00	45.7
2	1.84	36.2
3	3.72	31.5
4	9.44	0.57
5	22.34	0.29
6	38.32	0.14

The result is related to the structural composition. In Al coating Armco-iron, 2 methods have been used: the calorizing process and the hot-dipping process. Calorizing was done by heating the test bars in a powdered 52–59% ferro-aluminum alloy. In both cases, the life of the coating increases with the thickness of the Al bearing coating. The best results were obtained in calorizing with the 59% ferro-aluminum alloy (300 hrs. at 1000° C.). Calorizing offers advantages inasmuch as even intricate shapes can be coated. At any rate, coatings made with either method offer a remarkable retardation of the oxidation at higher temperatures. GN(4

Development of Adhesives for Foiling. Harry F. Perkins. *Oil & Gas Journal*, Vol. 28, May 1, 1930, pages 31, 103.

The development of adhesives for foiling is discussed. The resistance of various foiling materials to corrosive agencies is given in the following table:

Apparatus for Salt-Spray Corrosion Testing. (Dispositivo per saggi di corrosione.) F. Pietrafesa & O. Romano (Institute of Electrochem. and Electromet. Royal School of Engineering, Milan). *La Metallurgia Italiana*, Vol. 23, Mar. 1931, pages 198–199.

A glass nebulizing nozzle inserted vertically through a paraffined wooden base, carries the salt mist into a glass bell jar, so that the nozzle does not impinge directly upon any specimen. The specimens are supported in bakelite holders symmetrically about the nozzle, and their position need not be changed through the test. The salt solution is drained from the base of the bell jar, discarded if soluble corrosion products are formed, or filtered and returned to the cycle if they are insoluble. The air stream is scrubbed from oil by glass wool, and saturated with water vapor in the usual way. The complete set-up is shown in a photograph. HWG(4)

Examples of Corrosion as Met with in Practice, their Causes and Avoidance. (Korrosionsbeispiele aus der Praxis, ihre Ursachen und Vermeidung.) Karl Mandl. *Mitteilungen des Staatlichen Technischen Versuchsamtes in Wien*, Vol. 19, 1931, pages 48–53.

(1) Al rings as packing in ammonia refrigeration engines had to be replaced by asbestos or similar materials. (2) Cooling coils of Al of different qualities should not be welded together as corrosion can occur. (3) Iron condenser pipes should be galvanized. Lead covered roofing sheets were attacked by the atmosphere in a factory district. An addition of at least 10% Sn to the Pb, or previous tinning before leading, should be applied. Cast iron parts which come into contact with acid liquids must not be used and should be replaced by acid-proof metals or alloys. Ha(4)

Surface Protection of Light Metals. (Oberflächenschutz der Leichtmetalle.) Th. Leib & Fr. Kolke. *Korrosion und Metallschutz*, Vol. 7, Jan. 1931, pages 3–11.

Main viewpoints are given which must be taken into consideration when applying surface protection means. The results obtained with the various paints and lacquers as well as anodic surface protection treatment (Jirotka-Bengough) are collected in tables. Tests were made in which Allautal is submitted to a tempering process. The paper concludes with a critical discussion of accelerated tests of surface protections. EF(4)

The Action of Stationary and Moving Nitric Acid on Aluminum Sheet, Silumin Sheet and Ferrosilicon. (Ueber die Einwirkung ruhender und bewegter Salspetersäure auf Aluminiumblech, Siluminblech und Ferrosilizium.) M. P. A. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 50–51.

The attack on pure aluminum was slightly less by moving acid than by stationary acid. In contact with ferrosilicon, an increased attack could not be stated. Contact with 50% nitric acid results in a loss of 5 g./m.² surface in 24 hrs. Ha(4)

The Corrosion of Iron by Steam at High Temperatures and Its Physico-Chemical Basis. I. (Die Korrosion von Eisen durch Wasserdampf bei hohen Temperaturen und ihre physikalische-chemischen Grundlagen.) W. Krauss. *Korrosion und Metallschutz*, Vol. 7, Feb. 1931, pages 29–34.

A method is described for measuring the rate of oxidation of Fe in superheated steam at high temperatures. The method consists in measuring the increase in electrical resistance of a metal wire during the process of oxidation. The resistance $W = \frac{\varphi \rho_1 \rho_2 L}{\pi}\left[\frac{1}{\varphi r_2^2 \rho_1 + \rho_2 (r_1^2 - r_2^2)}\right]$ in which r_2 and r_1 are radii of the bare wire and the oxide covered wire; ρ_1 and ρ_2 the specific resistances of the metal and the oxide; φ the ratio of molal volumes of the metal and the oxide; and L the length of the wire. Measurements of resistance changes made at temperatures ranging from 500–800° C. and determinations of O_2 in the oxide film showed the ratio of O_2 used to Fe reacting to be approximately that found in Fe_3O_4. Separate determinations of weight increases due to oxidation of Fe in a furnace at the same temperatures were found to agree well with those calculated from the resistance changes. Both methods indicated that the thickness of the oxide layer increased with time according to the diffusion equation $y^2 = kt$ in which y = thickness in μ; t = the time in minutes. The values of k were determined for temperatures of 800, 700, 630 and 600° C. and were respectively 8.08×10^{-6}, 1.57×10^{-6}, 4.22×10^{-7} and 1.27×10^{-7}. Temperature coefficients for the reaction rate were found to be 3%/° C. between 600° and 700°; 1.5%/° C. between 700° and 800° C. (4)

How Quenching Media Affect Corrosion of Alclad Sheets. H. C. Kerr. *Iron Age*, Vol. 126, Dec. 11, 1930, pages 1758, 1821.

From a paper read before the National Metal Congress in Chicago on "Quenching of Alclad Sheets in Oil." Corrosion of duralumin is influenced by quenching medium particularly with reference to corrosion resistance. VSP(4)

Passivity Phenomena in Aluminum in Stationary, Very Dilute Acids and Alkalies. (Ueber Passivitätserscheinungen an Aluminium in ruhenden, sehr verdünnten Säuren und Laugen.) L. W. Haase. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 53–60.

The amount of aluminum dissolved in liquids is of practically no importance. The experiments of the Prussian Institute for Hygiene of Water, Soil and Air resulted in the following values for 1 m.² and 1 yr. and 99.5% pure aluminum: in ordinary drinking water, 230 mg./l.; potassium chloride solutions, 180 to 5200 mg./l. The formation of a protective film often completely prevents a further attack. The purer the metal, the more complete the protection of the film. Amounts of even more than 1 g./l. have no harmful effect on the human system. 26 references. Ha(4)

Basic Phenomena at the Electrolytic Oxidation of Aluminum. (Grundlagende Vorgänge bei der elektrolytischen Oxydation von Aluminium.) H. Ginsberg. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, June 1930, pages 81–84.

The chemical, electro-chemical and electrical processes going on with the oxidation of aluminum are discussed and the formation and solubility of the oxide film investigated. Above 60° C., no effective protective films could be obtained. Ha(4)

Inspection of the Annapolis Corrosion Tests. J. H. Gibboney, *et al.* *Proceedings American Society for Testing Materials*, Vol. 30, 1930, Pt. 1, pages 221–222.

Detailed data on inspection of black sheets of copper-bearing and non-copper-bearing soft steels and open-hearth irons exposed to atmospheric corrosion at Annapolis are given in a table. All failures are in non-copper-bearing materials (less than 0.15% Cu). HWG(4)

	Penetration—In./Yr.						
	Atmosphere in Vicinity of Sulphuric Acid Plant	Atmosphere in Vicinity of Chlorine Plant	Industrial Atmosphere	Oil Vapors from Cracked Distillate	Oil Vapors from Crane-Upton Crude	Oil Vapors Containing HCl	Oil Vapors from Crane-Upton Treated Naphtha
Tin	0.000354	0.0454	0.000204	0.0001235	0.0000604	0.0000854	0.000709
Lead	0.000267	0.001206	0.000213	0.000402	0.000259	0.000302	0.00049
Zinc	0.000963	0.0306	0.000187	0.00096			0.0074
Aluminum	0.0001078	0.0267	0.0001	0.000374	0.000129	0.000568	0.0033
Steel	0.01537	0.0115	0.00309	0.012	0.0193	0.0158	0.033

VVK(4)

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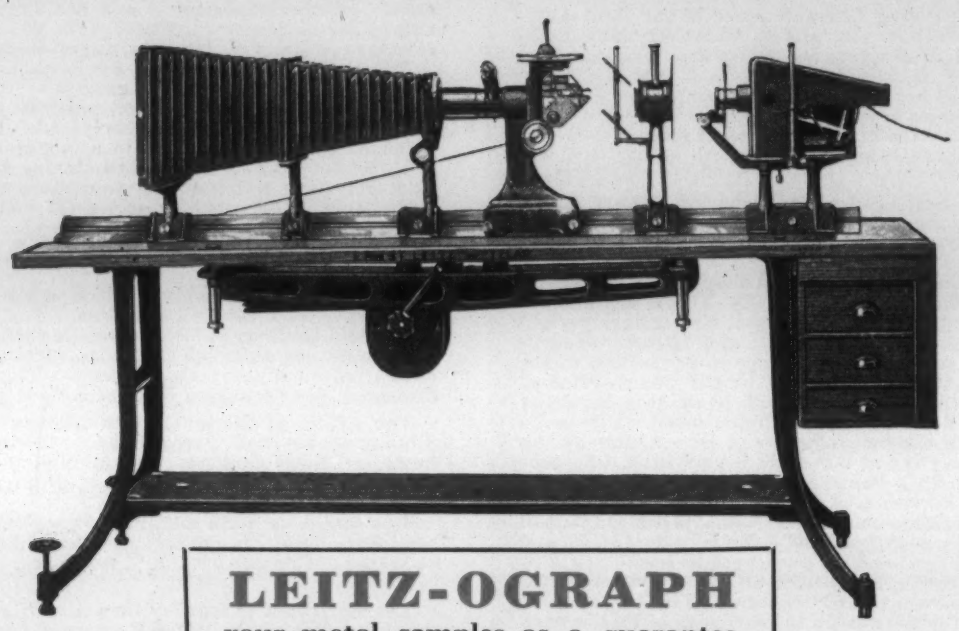

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STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Manganese a Stabilizer for Austenitic Structure. M. A. Grossmann (Republic Research Corp.). *Steel*, Vol. 87, Oct. 9, 1930, pages 68, 73.

Comment on paper by F. M. Becket on "Chromium-Manganese Steels" presented before the American Iron and Steel Institute. Presents photomicrographs of steels with 18% Cr, 7½% Mn and C content of 0.26%, 0.29%, 0.32% and 0.36%, respectively. Steels were quenched from 2100° F. Structure of first contained a mixture of austenite and ferrite and the steel was strongly magnetic. Structure became more austenitic and the steel less magnetic with increasing C. Last 2 steels had austenitic structure and were almost completely non-magnetic. Role of Mn is to stabilize the austenitic non-magnetic structure, which is first induced by the C. MS(5a)

A Study of the Relation between Macro- and Microstructure in Some Non-Ferrous Alloys. Marie L. V. Gayler. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 97–114.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. (5a)

The Diffusion of Aluminium into Iron. N. W. Ageew & Olga I. Vher. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 83–96.

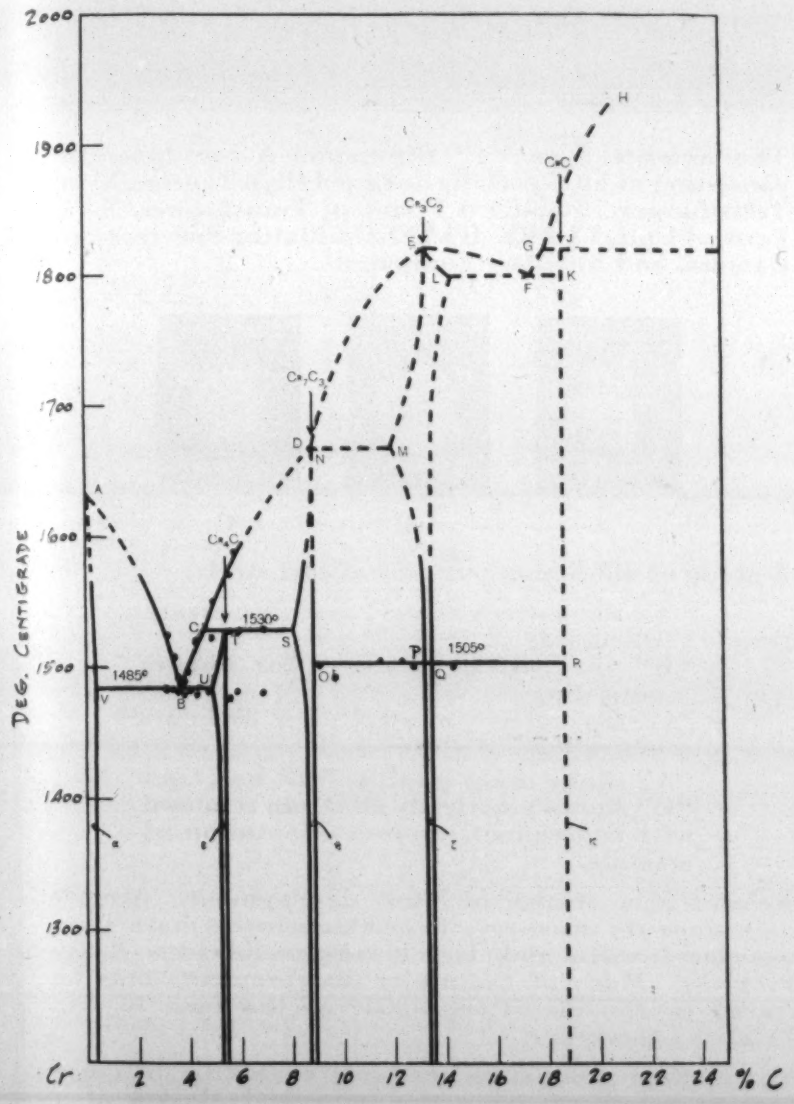
Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. (5a)

Structures of the High Chromium Stainless Steels and Irons. Edgar C. Bain (United States Steel Corp.). *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1419–1426; *Steel*, Vol. 87, Oct. 30, 1930, pages 57–59; Nov. 6, 1930, pages 66, 69, 70; Nov. 13, 1930, pages 57–58, 62.

Paper read before the American Iron and Steel Institute. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 34. MS(5a)

The Equilibrium Diagram of the Chromium-Carbon System. Kazue Hatsuta. *Kinzoku no Kenkyu*, Vol. 8, Feb. 20, 1931, pages 81–88.

The chromium-carbon system was studied by means of the thermal, microscopic and X-ray analyses and the equilibrium diagram, as shown in the diagram was proposed. In this system there exist four carbide phases, ϵ, η, ζ and κ corresponding to compounds, Cr_4C, Cr_7C_3, Cr_3C_2 and CrC (?) respectively. The crystal form of Cr_4C is cubic, Cr_7C_3 trigonal and Cr_3C_2 orthorhombic, but that of CrC was not determined. α- and ϵ-phases form a eutectic at 1485°, 3.7% C. ϵ- and η-phases are peritectically formed, according to the following scheme respectively: η + melt $\longrightarrow$ ϵ, ζ + melt $\longrightarrow$ η



The peritectic temperature for the former is 1530°, and that of the latter is above 1600°. ζ-phase probably has the maximum melting point on the liquidus curve and forms a eutectic with κ-phase; a transformation takes place at 1505° in this phase. TM(5a)

Dilatometric Investigations in Binary Magnesium-Aluminum Alloys in the Cast State. (Dilatometrische Untersuchungen an binären Magnesium-Aluminium-Legierungen in gegossenen Zustande.) Willi Claus & S. Breisemeister. *Aluminium, Hauszeitschrift der V. A. W. und Erftwerk*, Vol. 3, Jan.-Mar. 1931, pages 40–53.

This investigation was undertaken primarily to discover relations between shrinkage and heat expansion coefficients for pure aluminum and Mg-Al alloys. The diagrams of state are discussed and anomalies of solidification explained. The methods for the measurements of expansion are described, the results illustrated in numerous micrographs and equilibrium conditions of texture discussed. A direct connection between shrinking and expansion cannot be stated. There are 16 references and 2 appendices, one giving the numerical values of shrinkage and expansion coefficients, the other describing an apparatus of quartz-glass for determining the expansion coefficients at high temperatures. Ha(5a)

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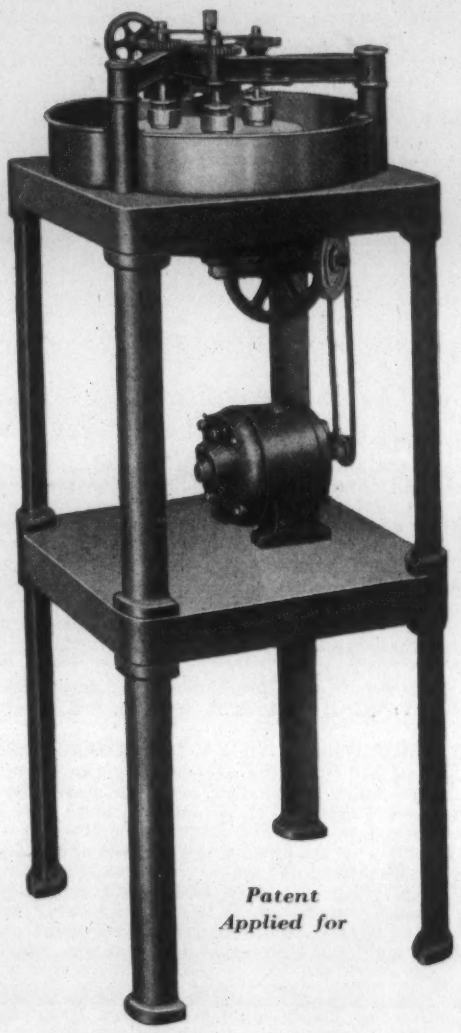

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Equilibrium between Iron Carbide and Iron Oxide. (Sur l'equilibre fer-carbure de fer-oxygene.) M. P. PINGAULT. *Comptes Rendus de L'Académie des Sciences*, Vol. 192, Jan. 5, 1931, pages 45–47.

The author describes very briefly experiments made with a view of obtaining a curve representing the equilibrium of the following reaction, $CO_2 + Fe_3C = 3Fe + 2CO$, at atmospheric pressure. This curve is traced together with those obtained by Boudouard for the reaction $CO_2 + C = 2CO$ and by Chaudron for the reaction $CO_2 + Fe = FeO + CO$. The point of intersection between Pingault curve and that of Boudouard is in the neighborhood of 740° C. and 28% CO_2. Pingault finds the heat of the reaction $CO_2 + Fe_3C = 3Fe + 2CO$ to be −0.5 calorie and estimates the heat of formation of cementite to be −27.5 calories. OWE(5a)

Solubility of Silicon in Aluminum in the Solid State. (Solubilita allo stato solido del silico nell'alluminio.) L. LOSANA & R. STRATTA (Royal School of Engineering, Turin). *La Metallurgia Italiana*, Vol. 23, Mar. 1931, pages 193–197.

Using Al and Si of such purity that Fe ran from 0.02 to 0.04%, Cu about 0.01%, Ca trace to 0.015%, Mg and Na trace, some 20 alloys ranging from 0.03 to 2.88% Si were made up. The solidus and liquidus were determined by thermal analysis. The solid solubility of Si in Al was determined by differential thermal analysis, using a slow rate of cooling, and by dilatometric methods. Rockwell hardness determinations were used to determine the curve from 0.23 to 0.03% Si, the specimens being heated at the rate of 10° or 15° C. per hour to the quenching temperature, held there for 24 hours, and then water quenched. The annealing temperatures ranged from 50° to 400° C. by 50° steps. From the hardness it was concluded that the room temperature solubility of Si lies between 0.07 and 0.1%. The solubility is a maximum at 576° C. and 1.75% Si. The course of the solubility curve from 300° up, as determined by Losana and Stratta, coincides most closely with that of Gwyer and Phillips, the solubility at 500° C. being set at about 0.5% Si instead of about 0.7% (Gwyer and Phillips), 1% (Dix and Heath), or 1.2% (Köster and Muller). Dix and Heath used wrought material, while Losana and Stratta apparently used cast specimens, thus not taking advantage of the use of wrought material in order to obtain equilibrium more readily. HWG(5a)

The Microstructure and the Hardness of Quenched Manganese Steels. TAKEJIRO MURAKAMI & KAZUE HATSUTA. *Kinzoku no Kenkyu*, Vol. 8, Mar. 20, 1931, pages 132–139.

Manganese steels containing less than 12% Mn and 1.2% C were quenched from 900° or 1200° C. in water or oil. From the result of microscopic observation of these quenched specimens, the constitutional diagrams for respective quenching conditions were constructed and the effect of the compositions and the quenching conditions upon the microstructure was demonstrated. The Shore hardness was measured for these quenched specimens and the relation between the hardness and the microstructure, as well as the compositions and the quenching conditions were discussed. The fact that the formation of martensite from austenite is markedly accelerated by quenching stress was shown in many specimens. TM(5a)

A Quantitative Determination of Martensite and Austenite in Quenched and Tempered Steels. K. HONDA & S. SEKITO. *Kinzoku no Kenkyu*, Jan. 1931, pages 8–13.

The method used in the quantitative determination is the same X-ray analysis as described in the foregoing article. Austenitic manganese steel was also treated in the same way. The average intensities of 200 Kα of austenitic manganese steel and of 111 Kα of gold were first compared and then the latter was compared with the intensity of 200 Kα of quenched or tempered steels. In this way the percentage content of austenite or martensite was calculated. The results were as follows: α-martensite having a tetragonal lattice (axial ratio is nearly 1.06) changes completely into β-martensite having a body-centered cubic lattice, in a range 100° to 170° C. The residual austenite changes into β-martensite only slightly up to 200° C., but very rapidly above 200° and this transformation is completed at 240° C. KT(5a)

The Recrystallization of Technical Lead. (Die Rekrystallisation von technischem Blei.) E. LOOFS-RASSOW. *Metallwirtschaft*, Vol. 10, Feb. 27, 1931, pages 161–165.

Contains 4 references. The grain size of 17 grades of Pb was determined after casting them into strips, reducing them 50% by rolling and annealing for 15 hours at 200° C. Electrolytic Pb has a grain size considerably above 1 mm., commercial Parkes Pb about 1 mm. and Pattison Pb and Pb alloys less than 1 mm. Elements like Cu and Ni which are not soluble in Pb reduce its grain size, while Bi, which is soluble, does not. Samples of one of each of the three grades of Pb were reduced from 6 to 87% and annealed at from 18° to 310°. Grain size was determined and recrystallization diagrams constructed. The increase in grain size with rising annealing temperature is gradual for the first two grades, but Pattison Pb hardly changes up to 280°, then suddenly becomes larger than the other two. The lower recrystallization limit is above room temperature for very low deformations, below for higher deformations. There was no difference in the recrystallization grain size of samples rolled at room temperature and at −70°. Long aging of rolled samples at room temperature produces normal recrystallization with higher deformations and grain recovery with low deformations. CEM(5a)

The Molecular Constitution of the η and H Solid Alloys and of the Corresponding Liquid Solutions of the Copper-Tin Series Examined Thermodynamically. F. H. JEFFERY. *Transactions of the Faraday Society*, Vol. 27, Apr. 1931, pages 188–190.

The solid η is the definite compound Cu_3Sn but the liquid phase is Cu_4Sn dissolved in monatomic tin molecules. The thermodynamic method also shows that if the liquid phase is Cu_4Sn in monatomic tin molecules, the solid phase H is a solid solution of Cu_3Sn in monatomic tin molecules. PRK(5a)

Practical Use of the Knowledge of Structure of Steels. (Utilidad practica del conocimiento estructural de los aceros.) F. GONZALEZ V. *Revue Quimica*, Vol. 6, July 1930, pages 21–25.

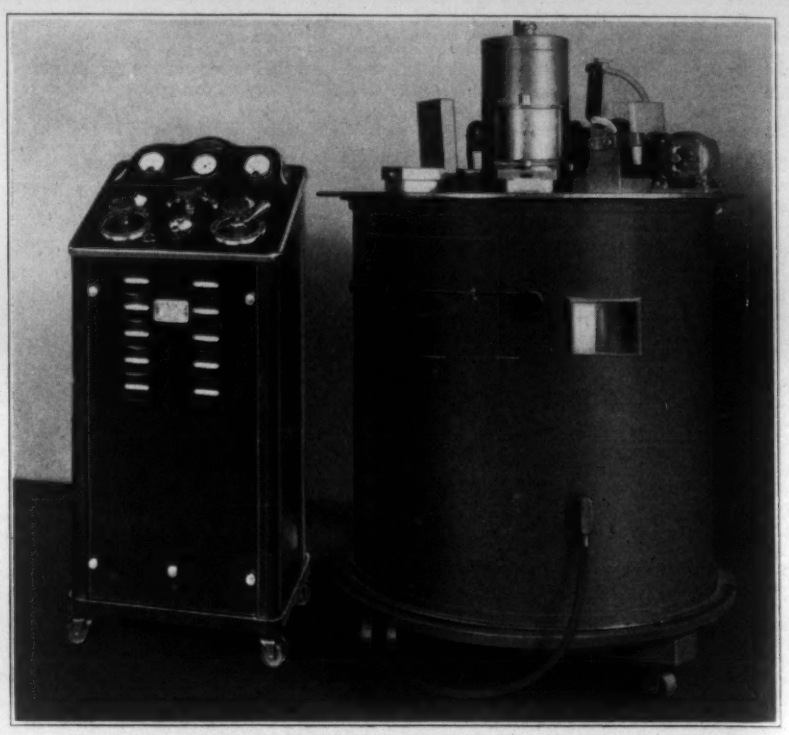
Based on the chemical composition of the steel an attempt is made to calculate all the structural phases existing in steel such as free pearlite, Mn_3C, MnS, Fe_3P and free ferrite. Juptner, Neil and Osmond formulas have been used in calculating tensile strength, hardness and elasticity. GTM(5a)

Practise Exercises in Metallography. (Travaux pratiques de metallography.) W. BRONIEWSKI. Translated from Polish into French by G. Pruszkowki. Preface by H. Le Chatelier. Dunod, Paris, 1930. Paper, 6¾ × 9 inches, 110 pages. Price 28.50 Fr.

This laboratory instruction book in metallography outlines exercises in metallographic examination, with reference to equilibrium diagrams of the alloys studied; deep etching; recognition of inclusions; thermal analysis; effect of quenching and tempering; carburization; annealing of cold worked alloys; pyrometry; hardness testing; and welding.

Sketches are shown for the set-up of each experiment and the technique of, and the interpretation of, each type of examination are discussed. Going through such a course under a good instructor would be good training for the student. The pamphlet is of special interest as showing the type of instruction in metallography that is given abroad.—H. W Gillett (5a)-B-

FOR THE ANALYSIS OF CRYSTAL STRUCTURE OF MATERIALS



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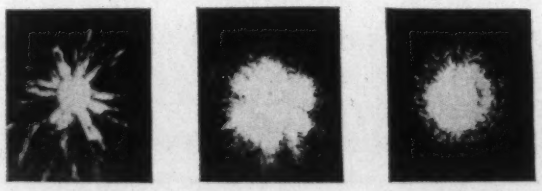

A B C

A group of diffraction patterns of cast steel:

"A" the pattern of steel as it came from the mold;
"B" the pattern of steel after 5 hours annealing;
"C" the pattern of steel after 20 hours annealing.

"A" shows many strains, "B" less, and "C" shows practically all strain removed with consequent random orientation of crystals.

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Structure & X-Ray Analysis (5b)

Non-Destructive Testing of Metals—Present and Future. ANCEL ST. JOHN. *Iron Age*, Vol. 127, Jan. 1, 1931, pages 54–55.

The ability to distinguish between permissible and non-permissible defects is the rock upon which non-destructive test methods have failed. Non-destructive tests will develop along two lines. One will be concerned with distinguishing normal material from abnormal. The other will be directed to distinguishing abnormal material which is permissible from that which must be rejected. VSP(5b)

Three Crystalline Modifications of Electrolytic Chromium. KUMAZO SASAKI & SINKITI SEKITO. *American Electrochemical Society, Preprint* 59–25, April 1931 meeting, 7 pages; *Journal Society of Chemical Industry*, Japan, Vol. 33, Nov. 1930, pages 482B–485B.

X-ray spectra were made of chromium electrodeposited from acid chromic sulphate solutions. At current densities below 15 amp./dm.^{2} the body-centered cubic form is deposited; above 18 amp./dm.^{2} the hexagonal close-packed form; and at intermediate current densities both the cubic and the hexagonal modification are deposited. The effect of bath temperature is very apparent. At 20° C. or below the hexagonal form was obtained; at 26° C. the body-centered cube only. Chromium plates made from chromic acid baths were always cubical with a lattice constant equal to 2.877 ± 0.003 A. U. The hexagonal modification is gradually transformed into the cubic even at room temperature. MB(5b)

The Determination of Crystallite Orientation. G. TAMMANN. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 29–73.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 908. (5b)

The Constitution of the Cadmium-rich Alloys of the System Cadmium–Silver. P. J. DURRANT. *Metal Industry*, London, Vol. 38, Apr. 17, 1930, pages 403–406, 415.

Paper given at Institute of Metals, March 11–12, 1931. See *Metals & Alloys*, Vol. 2, May 1931, page 97. PRK(5b)

Lattice Distortion as a Factor in the Hardening of Metals. WM. L. FINK & KENT R. VAN HORN. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 241–254.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. (5b)

The X-Ray and Welded Structures. H. R. ISENBURGER. *Welding*, Vol. 2, Apr. 1931, pages 229–231.

A brief enumeration of the advantages of this method of testing without destroying or impairing the test piece. Some practical arrangements for making exposures are illustrated. Ha(5b)

The Lattice Constants of the Gold-Silver Alloys. (Die Gitterkonstanten der Gold-Silberlegierungen.) G. SACHS & J. WEERTS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 109–113; *Zeitschrift für Physik*, Vol. 60, 1930, pages 481–490.

Precision measurements of the lattice constants of Au-Ag alloys give:

% Ag.	Observed Constant A. U.	Calculated Constant A. U.
0	4.0700	4.0700
2.0	4.0692	4.0694
4.9	4.0686	4.0687
6.1	4.0690	4.0685
19.9	4.0674	4.0672
35.5	4.0678	4.0678
49.9	4.0693	4.0694
59.9	4.0708	4.0708
65.3	4.0722	4.0717
84.8	4.0744	4.0750
89.6	4.0760	4.0758
94.5	4.0766	4.0766
100	4.0777	4.0777

The calculated values are from the parabolic formula

$$a = K \cdot A_{Ag} + (1 - K)A_{Au} - 0.0240K(1 - K)$$

where K is the atomic fraction of Ag. The deviation from a straight line relationship is very great. For instance, at 50 atomic % (35.5% by weight) the constant on the straight line assumption would be 4.0739 instead of 4.0678. HWG(5b)

The Orientation of Single Crystals Obtained Through Recrystallization. (Die Orientierung einzelner durch Rekristallisation gewonnener Kristalle.) G. SACHS & J. WEERTS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 92–94; *Zeitschrift für Physik*, Vol. 59, 1930, pages 497–500.

The orientation of the large crystals of Al and its alloys decidedly favors the face diagonal [110] if the content of impurities is small. But in the presence of impurities, the cube edge [100] and the cube diagonal [111] are favored, and as Si increases, the cube diagonal is chiefly favored, as shown in the following table for an alloy with 5% Cu.

Si %	Fe %	% Near [111]	% Near [100]
.25	.27	91	9
.34	.29	81	19
.35	.34	59*	35*
.38	.29	41	59

* 6% in intermediate positions.

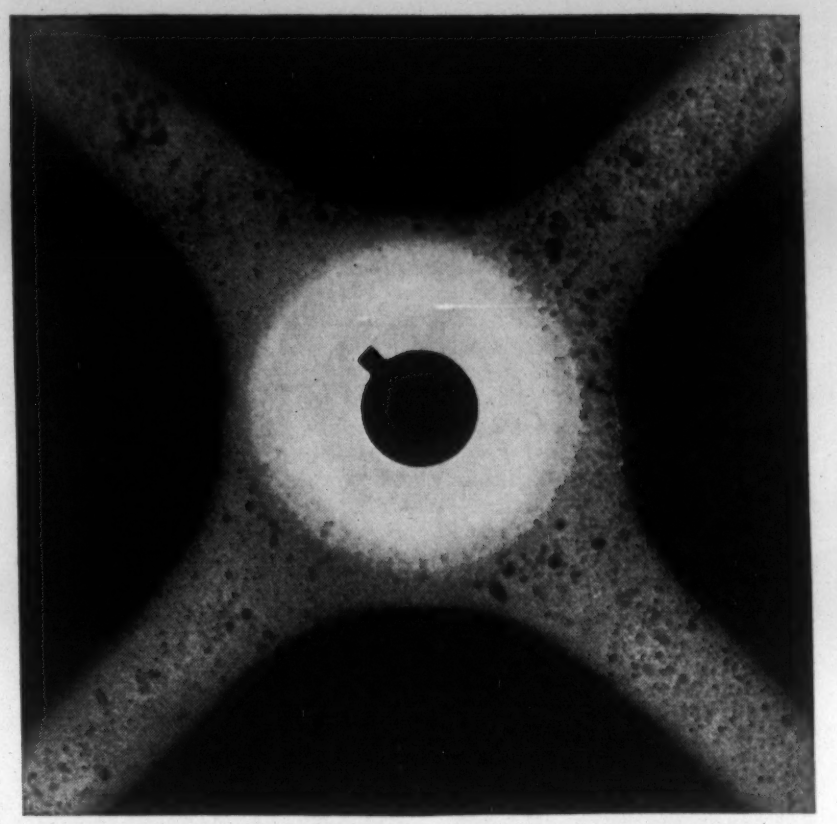
Plots are shown for the observations on which this table is based; also, for Al of various degrees of purity. HWG(5b)

X-Ray Investigation of Cementite Obtained by Tempering Quenched Steels. SINKITI SEKITO. *Kinzoku no Kenkyu*, Japan, Jan. 1931, pages 1–7.

The quantitative determination of the cementite obtained by tempering quenched steels was carried out by X-ray analysis. Quenched specimen 5 mm. in diameter was put at a point 2.5 mm. from the center of the Debye-Scherrer camera. A thin gold film 4.6 mm. wide and 0.04 mm. thick was longitudinally wound on a part of the surface of the specimen, so that the spectral lines of gold and cementite were given in the same film. Putting the intensity of the gold line as a standard line of reference, the intensity of the cementite line was compared. Seven Swedish steels of 0.2 to 1.4% carbon were investigated and the following results were obtained: the intensity of the spectral lines of cementite in annealed steels is proportional to the content of carbon. The spectral lines of cementite in quenched steels begin to appear by tempering at about 300° and attain their full intensity at 550° to 600° C. By a prolonged heating at 300° to 400° C., the cementite molecules precipitated from martensite build up crystals characteristic of cementite, and consequently the spectral lines of cementite become detectable. KT(5b)

X-Ray Inspection of Welds in Pressure Vessels. ANCEL ST. JOHN. *Iron Age*, Vol. 126, Dec. 18, 1930, pages 1828–1832.

X-rays are produced when electrons, traveling at high speed in an exhausted bulb, strike a heavy target of W placed at the center of the bulb. The X-rays are passed through wall of the vessel including welded seam. Cavities, cracks and inclusions appear as dark regions on print. X-ray equipment was installed at Barberton, Ohio, for Babcock and Wilcox Co. Describes apparatus installed and method of procedure. VSP(5b)



Section of die-cast aluminum alloy. The radiograph shows clearly the defects due to blowholes.

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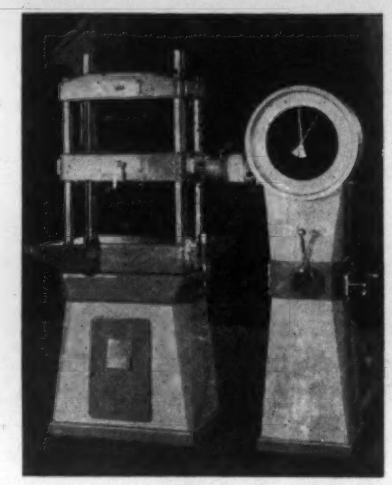
New Precision Hydraulic Universal Testing Machine

This new testing machine of the Riehle Bros. Testing Machine Co. is built in three distinct units; the Loading Unit, the Indicating Unit and the Power Unit.

Loading Unit—This part of the machine has the customary upper and lower heads in which are the grips for tension testing. The upper head rests on four rods attached to the table while the lower head is sustained by two large screws set into the base of the machine. Bronze nuts in this lower head, rotated by a motor and worm drive, serve to move the head up or down for adjustment. This drive is never used for testing.

The table is supported on the ram, which with its cylinder is housed in the base casting. When hydraulic pressure is applied to the ram it lifts the table and with it the upper head. As the lower head is stationary, it is evident that a specimen gripped in the upper and lower heads will receive a tensile load while one placed between the table and lower head will be loaded in compression. The ram and cylinder are ground to a fit of such precision that no packing is required to hold the pressure.



A slight leakage maintains a film of oil between the surfaces of the ram and cylinder and practically eliminates friction. The hydraulic pressure in the cylinder is, therefore, a function of the load on the specimen and affords an accurate and dependable means of measuring that load.

The Gripping Mechanism—The gripping mechanism is claimed to be the most striking innovation in the loading unit of the machine. The grips themselves are of the familiar wedge type, but where the usual type grips must be moved up or down to seize the specimen, these grips move horizontally until they engage. When the specimen is strained they then slip on inclined surfaces as in the usual type, so as to maintain their hold on the specimen.

Gripping and releasing is accomplished by turning a small crank handle. No liners are required and no part of the mechanism extends above or below the head.

Weighing Unit—Pressure from the main cylinder is brought through a transfer valve so that it may be applied, at the will of the operator, either on one plunger working singly or on two plungers working in opposition. These plungers are also of the unpacked or floating type and are oscillated rapidly by an individual motor drive so that friction effects are entirely eliminated. Whether one plunger is working alone or both plungers opposed, the resulting effort is counterbalanced by the buoyant effect of a steel float in a pool of mercury.

The sizes of the float and of the mercury container are so chosen that a small motion of the float produces a relatively large change in the mercury level. This results in a very sharply marked equilibrium point which not only makes for accuracy but also completely prevents surging in the event of rapid change of load.

When the single plunger is working, the hydraulic pressure on its cross-section area at one-fifth the total capacity of the machine is sufficient to submerge the float its full depth. When the two plungers are working in opposition it requires the full capacity pressure to submerge the float its full depth. This arrangement obviously affords a simple and direct means of obtaining full scale load indications either at full capacity or one-fifth capacity as desired.

The travel of the float is transmitted through a rack and pinion to a pointer moving across the face of a twenty-inch dial. The pointer actuating mechanism is very simply and ruggedly constructed.

Owing to the relatively large forces employed in the float assembly it is possible to use heavy construction in the indicating mechanism without loss in sensitiveness, thus insuring long service with little or no maintenance cost. The dial face itself is graduated and marked for both full and fractional scales so that both are always available. Changing from one to the other involves only the manipulation of the transfer value which can be accomplished in a few seconds. A maximum pointer is provided and the whole dial face closed by a plate glass cover to protect the dial and pointer from injury.

The indicating unit, in addition to its primary function, serves as a mounting for the necessary electrical and hydraulic controls. Immediately under the dial is the single pump control lever. This enables the operator to regulate the flow of oil with the utmost sensitiveness and accuracy. On the left side is the push button station controlling the pump motor and immediately adjacent to it is the double throw switch for running the lower head up or down. On the right is the transfer valve for charging the load indicating scale and immediately above it is the knob for adjusting the pointer to zero.

Power Unit—This is located directly in back of the weighing unit. The pump is a six-plunger variable stroke high-speed pump mounted in the oil tank and driven by a constant speed motor through a chain transmission. The flow of oil is continuous and regular without pulsations. The delivery is regulated by a cam, operated by the control levers on the front of the weighing unit, which adjusts the stroke as desired. When in the "off" position, a further motion of the cam opens a discharge valve which permits the load plunger to return to its starting point. All oil entering the pump passes through a filter which effectively prevents the entrance of dirt or chips into the system.

◆ ◆ ◆

One Good Method of Eliminating Overhead

Under present conditions it is refreshing to know that at least one manufacturer has solved his business problems, by a novel method of buying, manufacturing and marketing. He is unconcerned about fixed charges, frozen assets and the much discussed bugaboo of overhead. In fact, his gross and net profits have so much in common that one would hardly question the success of his business procedure. This manufacturer is Mr. P. Haleen, tool maker of 10047 Wentworth Ave., Chicago. He buys his steel, makes his tools and sells them, all in one day, giving the industrial world something to shoot at in the way of quick turnover. It must be mentioned that Haleen takes his tool shop with him and manufactures his products on the way to market.

The above photograph was taken of Haleen's traveling tool shop in front of the plant of Joseph T. Ryerson & Son, Inc. where he visited recently to obtain two 12 ft. bars of $^3/_8$ inch shafting, cut in 2 ft. lengths. The twelve short bars were rapidly transformed into one dozen rim wrenches, ready for sale shortly after the steel had cooled. Facilities for forging, punching and bending may be seen on the trailer.

This nomadic business is not limited to the manufacture of rim wrenches, but supplies the market with chisels, punches, bending bars and body straighteners as well. Entirely free of administrative and production problems, Haleen may concentrate his efforts on building up a substantial sales volume.

◆ ◆ ◆

Calendar of Meetings

International Foundry Exhibition and Congress, Milan, Italy, Sept. 12–27.

National Metal Congress and Exposition, Hotel Statler, Boston, Mass., week of Sept. 21.

American Welding Society.
Institute of Metals Division, A. I. M. M. E.
Iron and Steel Division, A. I. M. M. E.
Machine Shop Practice Division, A. S. M. E.
Iron and Steel Division, A. S. M. E.
American Society for Steel Treating.

American Gas Association, Atlantic City, N. J., Oct. 12–16.

National Safety Council, Chicago, Ill., Oct. 12–16.

Third International Conference on Bituminous Coal, Pittsburgh, Pa., Nov. 16–21.

American Institute of Chemical Engineers, Atlantic City, N. J., Dec. 9–11.

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

The Effects of Two Years' Atmospheric Exposure on the Breaking Load of Hard-Drawn Non-Ferrous Wires. J. C. HUDSON. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 409–431.

Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 909. (6)

Fatigue Properties of Welds. J. B. JOHNSON. *Welding*, Vol. 2, Mar. 1931, pages 159–163.

Describes some fatigue tests with results, from which it is concluded that the removal of the bead has little effect on a butt-welded seam on large parts but a considerable effect on small pieces about $^3/_4$ in. in diameter. Heat treatment such as annealing or normalizing will raise the fatigue limit. Improvement in welding technique which reduces the number and size of the oxide particles and blow-holes will also raise the fatigue limit. 6 bibliographic references. Ha(6)

"Pendulum" Hardness Tests of Commercially Pure Metals. D. A. N. SANDIFER. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 115–148. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 846. (6)

Instrument for Measuring Thickness for Continuous Testing of Thin Wires. (Ein Dickenmessgerät zur fortlaufenden Prüfung dünner Drähte.) SAMSON. *Elektrotechnische Zeitschrift*, Vol. 52, Apr. 16, 1931, pages 512–513.

The wire (for instance thin wires as used in filaments for incandescent lamps) is drawn through a pair of jaws one of which is movable and connected to one of two condenser plates so that the plate is moved when the thickness of the wire changes. The tiny movements of the condenser plates change the capacity of the condenser and as the latter is made part of an oscillatory circuit the change is translated into sound or it can also be recorded. A change of thickness of 1×10^{-4} mm. showed a deflection of the instrument of 0.8 mm. Ha(6)

Strip Steel for Razor Blades Is Tested Magnetically. H. R. SIMONDS. *Steel*, Vol. 87, Oct. 30, 1930, pages 51–53.

Auto Strop Safety Razor Co. has installed equipment for electromagnetic testing of strip. Unit consists essentially of 3 step-down transformers so arranged that any 2 may be electrically opposed and the current differential from the secondary winding measured on an oscillograph. Specimens to be tested are placed within the windings of the transformers to serve as cores. Differential oscillogram offers accurate comparison of specimens and by using a known standard in one coil it is possible to determine accurately such characteristics as microstructure, C segregation, defects, heat-treating results and C content. Transformers are mounted on a table about the size of an ordinary desk, and suitable switches and instruments are mounted near them. Oscillograph is in a separate dark room. Normally the oscillogram appears as a white line on a frosted glass surface. Some sample curves show the decrease in permeability due to an increase of 40° F. in quenching temperature, and the increase in permeability due to 80° F. increase in drawing temperature with quench temperature constant. Strip used is a Swedish annealed steel containing 1.25% C, 0.25% Cr, and less than 0.04% combined P and S. Magnetic tests are made before and after hardening. Manufacture of blades is by the continuous method. MS(6)

Weld Defects Are Detected by Stethoscope Tests. *Steel*, Vol. 87, July 24, 1930, pages 46–47.

From *Oxyacetylene Tips*, Vol. 8, Jan. 1930, pages 127–128, published by the Linde Air Products Co. See *Metals & Alloys*, Vol. 1, May 1930, page 524. MS(6)

Influence of Structure and Composition, Especially Phosphorous Content, on Wear Resistance of Cast Iron. (Einfluss des Gefügezustandes und der Zusammensetzung von Gusseisen auf die Verschleissfestigkeit, mit besonderer Berücksichtigung des Phosphorgehaltes.) T. KLINGENSTEIN. *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns*, Vol. 1, Sept. 1930, pages 18–24. 4 references.

A Hanfstaengel bearing testing machine was reconstructed into a wear test machine of the Spindel type. The specimen is pressed onto a rotary steel disk, apparently about 10 cm. diameter and of 5 mm. face, moving at 400 R. P. M. under a pressure of 5 kg. The depth of the groove cut into the cast iron specimen in 1500 R. P. M. of the disk is taken as a measure of wear-resistance. The size of the specimen and disk are not clearly stated. The specimens were cut from 1.2 in. diameter × 6 in. high bars cast upright. No data are given on the wear upon the steel disk. Using cast irons of 3.16. to 3.62% total C, 0.40 to 0.95% combined C, 1.74 to 2.72% Si, 0.73 to 1.06% Mn, 0.03 to 0.15% S, and with P varying from 0.09 to 1.89%, it was concluded that the wear resistance of cast irons with a ferritic ground mass increased about 100% as the P increased from 0.25 to 0.70%, thereafter increasing but slightly with higher P. At 0.70% the phosphide net work was quite continuous. With a pearlitic ground mass, the wear resistance was as good with low phosphorus as at 0.70% P in ferritic irons. Thin, long, graphite flakes are more desirable for wear resistance than thick short ones that break up the continuity of the ground mass. The wear resistance of irons of about 2.95% total C, 0.85% combined C, 1.75% Si, 0.70% Mn, 0.40% P, 0.10% S, was about the same as that of several Ni-Cr irons with 3.15–3.30% total C, 0.90–0.95% combined C, 0.80–0.95% Mn, 0.35% P, 0.10% S, and 0.45% Cr, 0.90% Ni or 0.75% Cr, 1.4% Ni. Wear resistance is not necessarily proportional to hardness. HWG(6)

The Bending Test for Aluminium Sheet. *Metal Industry*, London, Vol. 37, Aug. 29, 1930, pages 193–195.

The mechanical tests were made on Al sheet including: tensile strength, hardness, cupping values and bending values. Bending test is a useful indicator of the workability of sheet. Describes temper classification used for Al sheet. Sheet tempers for Al in British and American practice are:

American	British
2SO	Soft
2S2	Medium soft
2S4	Half hard
2S6	—
2S8	Medium hard
2SH	Hard

Using bend test, it is advisable to choose at least the next softest temper so as to allow a factor of safety for variation in run-of-mill production. Bending tests may also be used for tubes, rods and flat sections. Tabulates results of bending values of commercial sheets. VSP(6)

Elastic Measurements on Copper with a Martens' Mirror. (Elastische Messungen an Kupfer mittels Martensscher Spiegel.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 14, 1930, pages 3–7; *Messtechnik*, Vol. 4, Sept. 22, 1928, pages 231–236.

Refined measurements of copper which has been cold-stretched to various percentage extensions and then aged or heated to 100° C., indicated, by hysteresis and proof-loading tests, that the coefficient of elastic extension (reciprocal of the modulus of elasticity) may be considered as made up of one factor which decreases steadily as the degree of cold-stretching increased, and of another factor, due to the internal stress produced, the second factor increasing with the amount of cold work. The sum of the two factors makes the coefficient of elastic extension have a maximum, but at a rather small amount of cold work, since the internal stress increases rapidly at first, then more slowly as the amount of cold work is increased. Hook's law is not really obeyed, but is only a limiting case approached when the degree of cold-stretching is sufficiently great. The modulus of elasticity is different at every different load in fully annealed copper. Between the fully annealed and the severely cold worked states there is no true modulus; it varies with the load and with the previous history of the specimen. The purity of the copper used is not stated. HWG(6)

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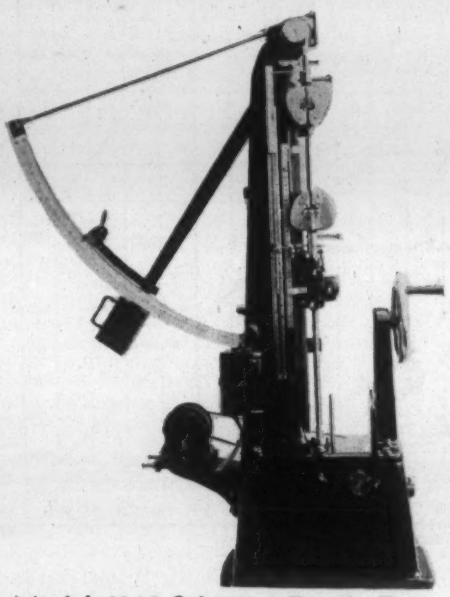

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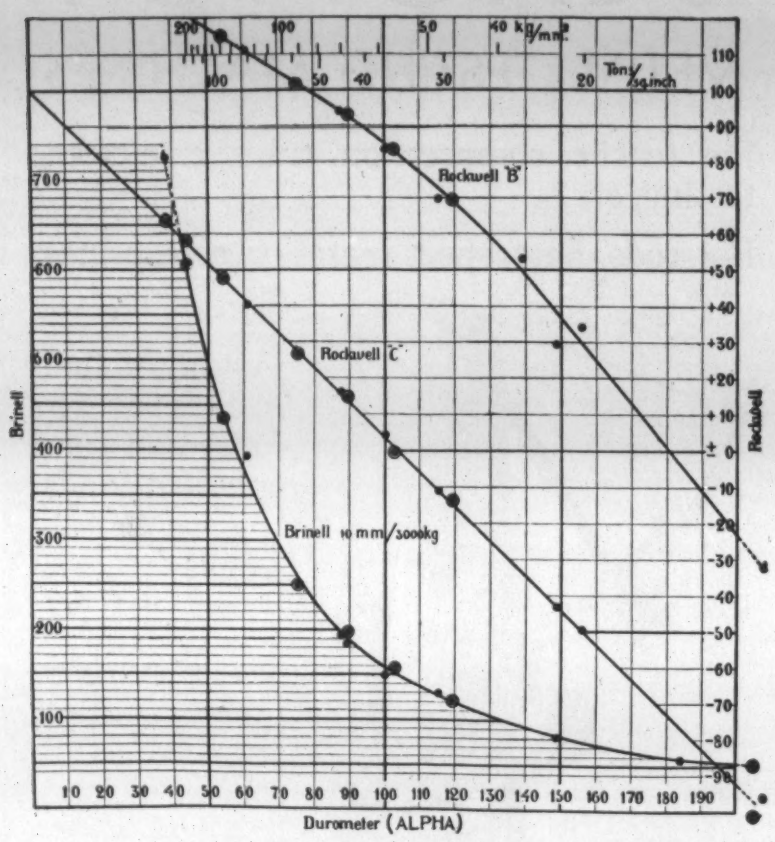
"Alpha" Hardness Tester for Steel. (Le durometer "Alpha.") RAYMOND SANCERY. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Apr. 1930, pages 183–186.

This apparatus is used to test the exact hardness of quenched steels. The diamond has an angle 120° and is applied with an initial load of 10 kg. This load is progressively applied to a final load of 150 kg. This tester



resembles the Rockwell machine, and in order to get the Brinell hardness the diamond point is replaced by a steel ball. A graph is given showing the relation of Alpha, Brinell and Rockwell hardness numbers. GTM(6)

Apparatus for Measurement of the Change in Cross Section of Loaded Bars. (Apparat zur Messung der Querschnittsänderungen belasteter Stäbe.) H. SIEGLERSCHMIDT. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 14, 1930, pages 22–27.

An instrument of the Martens' mirror type for measurement of the change in diameter of a tensile test bar, sensitive enough to be suited for use in determination of Poisson's ratio. The method of calibration is described. Determinations agreed within 3/1,000,000 in. or less, on steel specimens ranging from about $^1/_2''$ to $1^1/_2''$ diameter. All determinations on any of the bars, at any load from 570 to 5700 lbs./in.², showed Poisson's ratio within the limits 0.289 and 0.292. HWG(6)

Determination of Mechanical Properties of Steel. R. L. TEMPLIN. *Proceedings of Engineers' Society of Western Pennsylvania*, Vol. 46, Dec. 1930, pages 313–321; discussion 321–326.

Relationships between mechanical properties are first discussed, and then the methods for determining the properties, under which standardization is emphasized, as well as the recognition of the statistical element. Under testing machines and apparatus, the author deplores the fact that there are instruments which so far appear to be capable of merely testing a specimen without giving results of generally recognized significance or usefulness, and he gives numerous bits of advice in connection with selection, installation and operation. The discussions centered about the relationships between properties. MFB(6)

Changes in Electrical Conductivity in Strong Magnetic Fields. (Die Aenderung der metallischen Leitfähigkeit in starken Magnetfeldern.) H. J. SEEMANN. *Zeitschrift für Metallkunde*, Vol. 22, July 1930, pages 246–247, bibliography.

A critical discussion of the investigations of Kapitza on the changes in electrical conductivity of metals in varying magnetic fields up to 300,000 Gauss. EF(6)

The Bridge Methods of Testing Welds. J. R. BATCHELLER. *Welding*, Vol. 2, May 1931, pages 308–312.

Describes the X-ray and magnetic testing method used by the Babcock & Wilcox Boiler Works for testing boiler welds. Ha(6)

Critical Review of the Magnetic Methods for Testing Materials (Magnetic Analysis). (Kritische Betrachtung der magnetischen Verfahren zur Werkstoffprüfung [magnetische Analyse].) ERICH GEROLD. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund*, Vol. 2, No. 2, 1931, pages 23–37.

A discussion of methods used in the field of practical shop-testing of materials up to the middle of 1930, with special reference to work done in America. At first, the magnetic quantities are defined and it is shown how the physical properties of a material determine its magnetic conditions and how, by measuring the latter, defects in the material such as cracks, segregation, pipes, etc., can be determined and located. These magnetic methods are particularly superior to other test methods since they do not destroy the piece so that eventually every piece in any stage of fabrication can be tested. That these methods have not found the widest use is due very often to inconvenience in arranging the apparatus in the shop, especially for quantity testing. The several principles of magnetic testing are described with the instruments developed for this purpose; methods measuring the magnetic leakage, induction methods and saturation methods. Applications for testing of rails, pipes, ingots, welding seams, welds, wire ropes, turbine discs and hollow bodies are illustrated. A list of 66 bibliographical references is added. Ha(6)

Influence of Magnetic Fields upon the Mechanical Hardness of Alloys. (Beeinflussung der mechanischen Härte von Legierungen durch Magnetfelder.) E. G. HERBERT. *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 126–127.

Influence of magnetic fields upon changes in hardness of steel and duralumin is discussed. EF(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

Effects of Annealing on Chains. H. A. THOMAS (Carnegie Institute of Technology). *Transactions National Safety Council*, Vol. 1, 1930, pages 281–332. Includes Discussion.

Embrittlement of chain due to development of a cold worked skin, resulting in danger of failure under impact loading was discussed by Gough and Murphy for wrought iron chain in Engineering Research Rept. No. 3, British Dept. of Scientific Industrial Research 1928. They concluded that failure was not due to true fatigue. Similar studies were made by Thomas on soft steel chain stock. Instead of making true endurance tests, repeating overstressing loads were used which would cause failure in some 200,000 cycles. The original chain stock had a tensile strength of 48,000 lbs./in.² Under rotary bending stress of ±26,800 lbs./in.² failure occurred at 205,000–220,000 cycles. Annealing at 1500° F. for 30 min. followed by air cooling, on new specimens gave failures at from 156,000 to 252,000 cycles, averaging 175,000; if the scale was filed off, lives of 124,000–297,000 were obtained. If the specimens were first stressed for 100,000 cycles and then annealed, failures occurred in 1700 to 190,000 additional cycles. Annealing evidently does not heal the incipient fractures caused by overstress above the endurance limit. New specimens surface-hardened by hammering, increased in endurance resistance, lives of 228,000 to 1,147,000 cycles, averaging 600,000, being obtained. Failure of chains from presence of a work hardened surface is therefore not due to fatigue. Various impact and other tests for brittleness on steel and wrought iron chain links, surface hardened by mutual wear in use, or by a special laboratory set-up showed marked decrease in brittleness after annealing. Repeated load tests were made on chains as well as on chain stock. To remove danger from work-hardened surfaces it is recommended that wrought iron chain be heated to 1350–1375° F. and steel chain to 1600–1650° F. followed by air-cooling. Time at temperature should be $^1/_4$ hour for $^1/_4''$ to $^1/_2''$ chain, $^3/_4$ hour for $^1/_2''$ to $1''$, 1 hour for $1''$ to $1^5/_8''$ and 2 hours for over $1^5/_8''$. Pyrometric control should be used. The annealing or normalizing of steel chains or the removal of strain from wrought iron chains in this way does not remedy damage caused by repeated overstrain, but it removes embrittlement due to the work-hardened surface, which is the most serious cause of failure. HWG(6)

Fatigue Tests of Acetylene Welds. (Ueber Dauerprüfungen von Azetylen-Schweissungen.) BAUMGAERTEL. *Autogene Metallbearbeitung*, Vol. 24, Mar. 15, 1931, pages 81–87; Apr. 1, 1931, pages 96–99.

Exhaustive tests were made to compare the resistance of welds for continuous bending stresses with that of the solid material. The various methods and apparatus for such tests are described. Some of the results are given in the following table where λ is the ratio of the strength of the welded material to the solid material and φ is the ratio of the strength of the welded material to the tensile strength of the normal material:

	Tensile strength kg./mm.²	Fatigue bending strength (not welded) kg./mm.²	λ %	φ %
Norwegian welding wire	42.3	9.15	40.6	21.6
Mild steel wire	39.8	11.25	50.0	28.3
Vanadium steel wire	40.4	9.85	43.7	24.4
Chromium-molybdenum wire	41.8	5.62	24.95	13.4
Norwegian welding wire (bulge filed off)	37.6	11.95	53.1	31.8
Norwegian welding wire	35.5	16.85	74.9	47.5

Other tests with Cr-Mo pipes gave a ratio of λ of 55.8 to 64%. The author concludes that there is no doubt a fatigue limit in acetylene welds which is greatly influenced by the care with which the weld is made. Ha(6)

Determination of Endurance Limit of Nickel-Copper Alloys by Measuring Electric Resistance. S. IKEDA. *Kinzoku no Kenkyu*, Jan. 1931, pages 32–41.

The author's short time method of determining endurance limit of steels was applied to an annealed Ni-Cu alloy which forms a continuous solid solution. Electric resistance in specimens subjected to repeated bending stress was measured for different increasing stress. Up to a certain value of the applied stress, the electric resistance remained constant and afterward increased gradually; but the stress at which the resistance began to increase was quite distinct from and a little below the proportional limit of the static tension test. This stress may be considered the true endurance limit just as in the case of steels which consist of a minute mixture of cementite and ferrite. The constituent-endurance limit diagram suggests that a specimen containing about 65% Ni has the maximum endurance limit. The relation between the hardness number (sceleroscope, Brinell and Rockwell) and the endurance limit determined by electrical method or the specific resistivity may be represented by loop or a part of loop instead of a straight line as in the case of steels. KT(6)

Endurance Testing with the M. A. N. Repeated Bending Machine. (Erfahrungen über die Prüfung der Dauerfestigkeit verschiedener Werkstoffe auf der M. A. N. Biegeschwingungsmaschine.) A. JÜNGER (Maschinenfabrik Augsburg-Nürnberg). *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns*, Vol. 1, Sept. 1930, pages 8–18. 13 references.

The bulk of the endurance testing has been done on Wöhler-type machines. In spite of all the attempts at accelerated test methods that have been put forth, none is satisfactory. The disadvantage of the Wöhler method is the time required The M.A.N. machine takes a flat specimen, about 0.6″ wide, 0.2″ thick, and 6″ in the test section. By means of a magnet the specimen is vibrated in reversed bending some 2200 to 4100 cycles per minute. Jünger gives tests on some 2 dozen steels from which he calculates that for a polished specimen the formula $\frac{1}{5} \times$ (Tensile strength + yield point, both in metric units, + percentage reduction of area) gives the endurance limit within ±10%. The only non-ferrous material for which he gives the yield point is duralumin. The formula is not applied to this, nor does it give the endurance limit when one figures it out for a specimen tested in the longitudinal direction. The strongest steel included in Jünger's table is one of 145,000 lbs./in.² and no tests are presented to show how his formula works out on, say, a quenched alloy steel tempered at a low temperature. He advises direct endurance tests in preference to calculation, but finds the calculation helpful in choosing the test stress. Some comments and data are given on effect of rough machine finishes, scratches, corrosion and welding. The figures for endurance limits are about the same as are usually obtained for similar materials on other testing machines. The only ones of especial interest are for cast iron, as follows:

	C	Si	Mn	P	Bending lbs./in.²	Deflection in.	Tensile lbs./in.²	Brinell	Endurance Limit lbs./in.²
Ordinary	2.97	1.22	0.43	0.60	61,000	0.34	36,000	209	20,000
High Test	2.90	1.20	0.95	0.23	81,000	0.45	49,000	193	19,000

in which the endurance does not go up with the tensile strength. The ordinary iron had as fine graphite as the other HWG(6)

The High-Temperature and the Notched Endurance Limits of Some Ferrous Materials. (Ueber die Dauerbiegefestigkeit einiger Eisenwerkstoffe und ihre Beeinflussung durch Temperatur und Kerbwirkung.) EGON KAUFMANN. Julius Springer Verlag, Berlin, 1931. Paper, 6¼ × 8¾ inches, 89 pages. Price 9 RM.

A rotary bending Schenck endurance machine was provided with attachments for carrying out "accelerated" tests according to the method of Lehr. The deflection of the specimen under load, the torque exerted by the driving motor and the temperature rise of the specimen are all measured in this method. In order to apply the rise of temperature method at temperatures above that of the room, a hollow specimen was made, 0.42 in. outside diameter in the breaking section and a 0.2-in. hole drilled (before heat-treatment) axially through the specimen. A thermocouple was inserted at the center of the specimen in a holder carrying two slip rings to which the elements of the couple were connected. The couple and holder rotated with the specimen. Flexible copper brushes contacting with the slip rings connected the thermocouple to the galvanometer circuit.

The specimen was surrounded by a heating coil so that elevated temperature endurance tests could be made. The length of the cylindrical breaking section of the specimen was 0.4 inch. At 300° C. the temperature 0.2 inch from the middle of the specimen was 3° C. low, at 700° C., 7° C. low. The temperature of the outside of the specimen at the point of maximum load was not determined. The machine was run at 3000 R. P. M. Disks of sheet metal, 3½ in. diameter, 0.008 in. thick, rotating with the specimen were interposed between the heating furnace and the machine bearings. No other cooling of the bearings was required.

On the plots of the accelerated tests are shown three stresses, the first corresponding to the first, ill-defined knee in the temperature-rise curve, rarely to any definite knee in the torque curve of the motor dynamometer and never to any detectable knee in the deflection curve. The second is on the whole somewhere near to a change of direction in the torque curve, to one in the temperature-rise curve, and more or less in the neighborhood of a very slight change in the deflection curve. By dint of looking at all three curves, it is usually possible for the author to mark off a stress, "Sigma 2," that is supposed to correspond with the endurance limit in a real endurance test, but the exact position is often pretty much of a guess.

Actual endurance tests were then made and the endurance limits and the "Sigma 2" limits plotted for the various temperatures. On cast iron the curves coincide up to 500° C., the highest temperature at which actual endurance tests were made on the iron. On the two carbon steels the endurance curve is considerably above the accelerated test curve, while on the heat treated Ni-Cr steel it is considerably below it. The results do not indicate any particular utility for the accelerated methods.

The endurance tests, even at the highest temperatures, were not run to more than 10 million cycles (save for one bar of cast iron) and in several cases only 3 or 4 specimens were run. On the Ni-Cr steel at 400° C. there was no stress used between 71,000 and 63,000 lbs./in.²

The accelerated test results do not appear worth repeating. The endurance limits give the following data:

Materials	C	Si	Mn	P	S	Ni	Cr	Room Temp. Yield Point lbs./in.²	Room Temp. Tensile lbs./in.²	Static Test % Elong.	Static Test % Red. Area
	Percentage										
A7 carbon steel annealed	0.36	0.33	0.69	0.02	0.03	..	..	43,000	78,000	25½	60½
R6 carbon steel annealed	0.62	0.49	0.75	0.02	0.03	..	..	47,000	89,500	22½	51
Ni-Cr steel heat-treated	0.35	0.25	0.56	0.01	0.01	4.60	1.63	153,000	172,500	11	54
Lanz cast iron	3.19	1.09	0.82	0.12	0.13	..	..	.....	38,000	..	..

Endurance Limits

A7 (0.35% C)	20° C. 40,000; 325° C. 53,500; 550° C. 21,000±.
R6 (0.62% C)	20° C. 46,000; 310° C. 51,500; 425° C. 40,000; 550° C. 27,000; 710° C. less than 13,000.
Ni-Cr	20° C. 78,000; 100° C. 73,500; 200° C. less than 70,500; 300° C. 70,500; 400° C. 62,500±; 500° C. 46,000±.
Lanz cast iron	20° C. 14,000; 100° C. 13,000±; 200° C. 13,000±; 300° C. 15,500; 400° C. 16,500; 500° C. 14,000; 600° C. less than 10,000.

The cast iron specimens were taken from a hollow cylinder 27½ in. high, 25½ in. I.D., 1.6 in. wall thickness.

The endurance limits at 3000 R. P. M. are above the stresses at which the materials will fail through creep at high temperatures under static loading. Oxidation makes all endurance tests over 300° C. somewhat unreliable.

The same materials were tested after machining a round-bottomed notch of different depths in the breaking section. Room temperature endurance results on such notched bars follow:

	Notch Depth	Endurance Limit
A7	0.004	28,500
	0.012	22,500
R6	0.004	31,500
	0.008	27,500
	0.012	25,500
	0.200	23,000
Ni-Cr	0.002	51,000
	0.004	44,500
	0.008	39,000
	0.012	35,500
Lanz Iron	0.004	about 14,000
	0.200	about 14,000

As usual, the cast iron showed freedom from injury by the notches.

Steel R6 with 0.012-inch notch gave the following endurance limits at elevated temperatures: 150° C. 21,500; 330° C. 26,500; 425° C. 24,000; 550° C. 17,500.

The Ni-Cr steel with 0.004-inch notch gave: 100° C. 40,000; 200° C. 37,000; 300° C. 42,000; 400° C. 45,500; 500° C. 36,500

The fractures of the unnotched steel endurance specimens in the blue heat range were at 45°. At higher temperatures they were straight across the specimen, as were those of cast iron at all temperatures used. On all notched specimens at all temperatures the fractures were straight across.—H. W. Gillett (6)-B-

Working the Surface to Raise the Endurance Limit. (Das Oberflächendrücken zur Erhöhung der Drehschwingungsfestigkeit.) P. BEHRENS. *Veröffentlichungen des Wöhler-Institutes*, 1930, No. 6, 51 pages, 9 references 14 tables, 22 figures.

The damping limit of alloys is always increased by rolling the surface under pressure. The damping ability may be raised or lowered. The endurance limits of specimens of various materials were as follows: open hearth steel 6 to 29%; an 0.06% C structural steel, 21 to 50%; a 0.29% C, 1½% Mn, 9% Cr steel of 107,000 lbs./in.² tensile, 12 to 24%; a 0.33% C, 1% Cr, 0.18% Mo steel of 131,000 lbs./in.², 4 to 12%; brass with 2.3% Pb, 10 to 16%; brass with 1.4% Pb, 0 to 33%; brass with 56% Cu, 1% Mn, 7% Pb, balance Zn, 3½ to 13½%; electron 1% Zn, 6.3% Al, 0.3% Mn, 3 to 38%. The endurance limits were calculated on the basis of only 2 million cycles. HWG(6f)

Improvements on the Testing Machine for Tension-Compression Stress. (Verbesserungen an der Materialprüfmaschine für Zugdruckbeanspruchung. Vorspannung und Selbsterregung.) A. ESAU & E. VOIGT. *Zeitschrift für technische Physik*, Vol. 11, Feb. 1930, pages 55–58.

Paper pertains to a fatigue testing machine which was improved in the Techn. Phys. Institute of the University of Jena. EF(6f)

Taking of Samples and Testing of Material for Rotors. (Probeentnahme und Werkstoffprüfung an Rotorkörpern.) ERNST FRANKE. *Elektrotechnische Zeitschrift*, Vol. 52, May 7, 1931, pages 600–601.

The stresses to which a dynamo rotor is exposed are discussed and the danger of fracture due to fatigue is pointed out. The fatigue fracture is explained as follows: the stress caused by rotation gives rise to forces of motion within the structure which in time loosen up the crystal structure and, finally destroy it. Fine cracks are formed which become larger and wider until the stress for the remaining material becomes too great and a sudden fracture takes place. It is shown how and where samples of the forged piece should be taken and which requirements the testing machines for such samples have to fulfill. A brief description of such machines is given. Ha(6)

Fatigue Strength of Steel Joints Welded with Oxy-Acetylene. (Dauerfestigkeit der mittels Azetylen-Sauerstoff geschweissten Stahlverbindungen.) W. HOFFMANN. *Autogene Metallbearbeitung*, Vol. 24, Apr. 1, 1931, pages 99–102.

Reproduction of results of tests in tables and microphotographs, made on steel tubing, especially as used in airplane construction, for tensile strength, elongation, fatigue strength. With oxy-acetylene welding, an average of 90% of the normal values of the above mentioned properties can be attained. Fatigue tests gave 50 to 60% of the values of the normal material. Ha(6)

Machines for Fatigue Testing. (Maschinen für Dauerversuche.) W DEUTSCH. *Zeitschrift für Metallkunde*, Vol. 22, Feb. 1930, pages 56–61. See *Metals & Alloys*, Vol. 1, May 1930, page 524. (6)

The Effect of Surface Conditions and Electrodeposited Metals on the Resistance of Materials to Repeated Stresses. R. H. D. BARKLIE & H. J. DAVIS. *Proceedings Institution of Mechanical Engineers*, No. 3, May 1930, pages 731–750.

See *Metals & Alloys*, Vol. 2, May 1931, page 100. RHP(6)

Studies Physical Qualities of Manganese and Alloy Steels. *Steel*, Vol. 87, Oct. 2, 1930, pages 71, 73.

Mn steel often attains a hardness of 550 Brinell under cold working in service. American Manganese Steel Co. has made numerous tests comparing the physical properties of work-hardened Mn steel with those of heat-treated alloy cast-steels. Some of these are presented graphically. These show that when the Fahrenwald abrasion factor was 150 for both, Mn steel had a tensile strength of 125,000 lbs./in.², surface hardness of 550 Brinell, elongation of 45%, and work factor of 3640 ft. lbs./in.³, while the corresponding values for the alloy steel were 220,000 lb./in.², 650, 0.70% and 58 ft. lbs./in.³ When compared on the basis of a tensile strength of 125,000 lbs./in.² for both, the alloy steel had a surface hardness of 275, elongation of 15%, abrasion factor of 110, and work factor of 1550 ft. lbs./in.³ On the basis of identical Brinell hardness of 550, the alloy steel had a tensile strength of 200,000 lbs./in.², abrasion factor of 120, elongation of 2%, and work factor of 242 ft. lbs./in.³ MS(6)

More on Endurance Testing with the M. A. N. Machine. (Weitere Erfahrungen in der Prüfung der Dauerfestigkeit verschiedener Werkstoffe auf der M. A. N. Biegeschwingungsmaschine.) A. JÜNGER. *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns*, Vol. 1, Feb. 1931, pages 45–58. 12 references.

The formula connecting endurance limit and the sum of the tensile strength, yield point and reduction of area is applied to some 20 more lots of steel, with fair concordance with experimental endurance data, but none of the steels were heat-treated to a very hard condition. A series of tests on specimens machined so that the planer tool marks were longitudinal or transverse, and of varying depths, as well as on polished, scratched and corroded surfaces, was run. Photographs of the surfaces are shown. The transversely planed specimens compared with those ground longitudinally showed a reduction in endurance limit ranging from 4% on the softest steel to between 40 and 50% for the harder steels. Specimens cut longitudinally and transversely from a crankshaft showed 10 to 25% lower endurance transversely. The static transverse data are not given so the applicability of the formula cannot be checked. Cylindrical specimens can be used instead of flat ones, the results agreeing fairly well. Using round specimens and spraying distilled water on them during the test for corrosion-fatigue, three steels showed 25 to 60% reduction in endurance limit. Similar spraying for 100 hours before the endurance test gave 10 to 30% reduction. The drop in endurance limit due to pre-corrosion was about the same as on specimens rough-planed transversely. The steel that was least affected by pre-corrosion was the most affected by simultaneous corrosion. One steel of .35% C, 88,000 lbs./in.² tensile, 52,000 lbs./in.² yield, 21.5% elongation, 55% reduction of area, 7 mkg./cm.² impact (Mesnager notch), was tested for endurance limit at elevated temperature. A heating coil was placed about the lower part of the specimen, just below the fillet, and a thermocouple inserted in a central hole extending through the lower part of the specimen nearly to the fillet. No calibration for temperature distribution is given and there is no certainty that the temperature at the breaking section may not have been considerably lower than that measured, especially at the higher temperatures. The endurance limits given are:

Temperature °C.	Temperature °F.	Endurance Limit lbs./in.²
Room		42,500
200	390	45,500
300	570	48,500
450	840	45,500
500	930	40,000

HWG(6)

Failure of Metals under Repeated Stress. H. F. MOORE & T. VER. (University of Illinois.) *Metal Stampings*, Vol. 3, June 1930, pages 567–568; *Metallurgist*, Sept. 26, 1930, pages 141–142.

Summary of University of Illinois Engineering Experiment Station Bulletin. See A Study of Slip Lines, Strain Lines and Cracks in Metals under Repeated Stress. *Metals & Alloys*, Vol. 2, May 1931, page 99. MS(6)

A Study of Slip Lines, Strain Lines and Cracks in Metals under Repeated Stress. H. W. GILLETT. *Metals & Alloys*, Vol. 1, Sept. 1930, page 731. A critical abstract. See *Metals & Alloys*, Vol. 2, May 1931, page 99. ESC(6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Contamination of Solutions. F. J. LISCOMB (Hanson-Van Winkle-Munning Co.). *Metal Industry*, N. Y., Vol. 28, Sept. 1930, pages 427–429.

From monthly review of the American Electroplaters' Society. Paper read at annual convention in Washington, D. C., June 30–July 3, 1930. Discusses the introduction of Fe into alkaline cleaning and electroplating solutions. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 8. VSP(7a)

Electrodeposition of Silver from Sulfate, Nitrate, Fluoborate and Fluoride Solutions. EDWARD B. SANIGAR. *American Electrochemical Society, Preprint* 59–33, April 1931 meeting, 21 pages.

The possibility of electrodepositing Ag in a form suitable for electroplating purposes from silver sulphate, nitrate, fluoborate and fluoride solutions has been studied. Owing to the simple-immersion deposition of Ag from these solutions upon Cu, Ag, brass and Ni, adherent deposits were obtained only upon Ag. Relatively compact deposits of Ag were obtained upon Ag deposited from an argento-cyanide solution, from silver sulphate solutions containing boric acid, silver fluoborate solutions and silver fluoride solutions. However, these solutions showed a great tendency to yield tree deposits, and the conditions under which deposits free from trees could be obtained were limited. All the compact deposits were decidedly crystalline, and while they might be of use in the electro-refining of Ag as a means of obtaining dense Ag deposits instead of the loose crystals given by the nitrate solution, they offer no serious competition to the usual argento-cyanide solution for the electroplating of Ag, unless considerable improvement can be made, for example, by the use of "addition agents." A further difficulty in the way of the use of these baths for Ag deposition is the unsatisfactory corrosion of the anodes. (7a)

The Change in Reflecting Power Caused by Tarnishing Electrodeposited Silver-Cadmium Alloys. LAWRENCE E. STOUT & WILLIAM G. THUMMEL. *American Electrochemical Society, Preprint* 59–29, April 1931 meeting, 12 pages.

Silver-cadmium alloys may be deposited from a commercial cadmium plating bath to which silver cyanide has been added. The composition of the alloy depends on the silver concentration in the bath (if the cadmium content remains constant) and on the cathode current density. The co-deposition of silver lowers the reflecting power of electrodeposited cadmium. The tarnishing of the alloys depends both on the composition and on the rate of deposition, and is materially less than that of pure silver. A silver-cadmium alloy containing about 24% of silver recommends itself as the best general purpose reflector. Its reflecting power is equal to that of pure cadmium, and it is considerably harder and more resistant to abrasion than pure electrodeposited cadmium. (7a)

Chromium Deposits Directly on Aluminum. HAROLD K. WORK & CHARLES J. SLUNDER. *American Electrochemical Society, Preprint* 59–18, April 1931 meeting, 7 pages.

Thin layers of chromium which have fairly good resistance to salt spray and atmospheric corrosion may be electrodeposited directly on aluminum. Such deposits have a gray color on leaving the plating bath and must be buffed if a higher luster is required. These deposits protect aluminum to a marked degree from alkaline corrosion. Heavy deposits for abrasion resistance have also been applied to certain aluminum alloys. (7a)

Modern Methods of Nickel Plating. (Les methodes modernes de nickelage.) MARCEL BALLAY. *Revue Générale de l'Electricité*, Vol. 28, Aug. 2, 1930, pages 182–187.

From *Bulletin de la Société Française des Electriciens*, Series 4, Vol. 10, May 1930, pages 545–571. MS(7a)

Progress of the Hot Nickel Solution. OLIVER P. WATTS. *American Electrochemical Society, Preprint* 59–20, April 1931 meeting, 5 pages.

A report is made of the volume and operating conditions of many of the hot nickel plating solutions now in use in the United States and Canada. Since there was an incubation period of five years between the announcement of the advantages of heating the nickel plating solution and its commercial adoption, the reported growth to 158,000 gallons has occurred in ten years. Opinions of platers on the respective merits of the hot and cold nickel solutions are included. (7a)

The Hardness of Electrodeposits. D. J. MACNAUGHTON & A. W. HOTHERSALL. *Brass World*, Vol. 26, July 1930, pages 159–161.

High spots of the discussion following the reading of the paper are outlined. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 841. WHB(7a)

Bright Silver Plating from the Cyanide Bath. A Preliminary Note. L. C. PAN. *American Electrochemical Society, Preprint* 59–15, April 1931 meeting, 6 pages.

Ammonium hydroxide added to a silver plating bath has a whitening effect upon the silver deposit, especially when the bath contains an appreciable amount of impurities which otherwise cause discoloration of the cathode deposit. Sodium thiosulphate added to the extent of 1 g./l. makes the silver deposit almost of mirror brightness. The combination of ammonia and sodium thiosulphate gives a still more effective brightener for the silver deposits from a cyanide bath. (7a)

Control of Acidity in Low pH Nickel Plating Baths. L. C. PAN. *American Electrochemical Society, Preprint* 59–28, April 1931 meeting, 8 pages.

For the control of acidity in low pH nickel plating baths, the titration method, including a "control chart" for direct readings, was found to be most practical in a commercial plant. It is based upon the assumption that for a given bath whose composition is kept approximately constant, the pH value will be the same as long as the acidity is maintained at the same point. The "control chart" also provides a direct method of regulating and correcting the acidity or pH, eliminating all labor of computation and all guesswork. (7a)

Further Developments in Low pH Nickel Deposition. W. M. PHILLIPS. *American Electrochemical Society, Preprint* 59–35, April 1931 meeting, 4 pages.

Further commercial work with low pH nickel baths indicates the following: (1) Deposits from low pH baths furnish better protection than those from high pH baths. (2) The hardness of deposits is not directly influenced by the pH. Nickel is softer from baths operated at elevated temperatures. (3) Pitting is no worse with low pH than it is with high pH baths. See also *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. (7a)

Buffer Action in Nickel Plating Solutions. KARL PITSCHNER (Firestone Steel Products Co.). *Metal Industry*, N. Y., Vol. 29, Mar. 1931, pages 119–120; *Brass World*, Vol. 26, July 1930, page 175.

From the *Monthly Review of the American Electroplaters' Society*, Feb. 1931. Includes discussion. By noting the change in pH, when sulphuric acid is added to solutions with different contents of Ni, boric acid and ammonium chloride, it was found that the buffer effect is high at pH 6 and at pH 2 but low at pH 4. In the plating range pH 6 to 5, the buffer effect is more noticeable when alkali is added than when acid is added, while in the lower range the reverse is the case. Below pH 4, boric acid has little buffer effect in quantities up to 4 oz./gal.; at pH 5.5 the buffer effect of 4 oz./gal. is twice as much as if no boric acid is present and at pH 6 it is $3^1/_2$ times as great. Increasing the nickel sulphate concentration markedly increases the buffer effect if above pH 4. Increasing the ammonium chloride concentration increases the buffer effect considerably if above pH 4. PRK + WHB(7a)

The Electrodeposition of Chromium and the Influence of the Cathode Metal. J. W. CUTHBERTSON. *American Electrochemical Society, Preprint* 59–26, April 1931 meeting, 24 pages.

In chromium plating the best results and greatest flexibility and reliability in operation are obtained from a solution of chromic acid and sulphuric acid. The molarity of the CrO_3 should not be greater than 3.25, and the ratio of this to SO_4 normality should be about 58 to 60. The tank should be lined with hard lead, the lining not being anodic to the solution except as a temporary measure. Lead is the only material that can be considered for anodes. The temperature should be reasonably high, but not above 45° C., as then the Cr III equilibrium concentration reaches too high a figure. Care should be paid to the ratio between anode and cathode surfaces. The anode area should be 1.5 to 3 times that of the cathode, and anodes should be disposed with respect to the cathode size and shape. Even under the best of conditions, the cathode current efficiency is not above 16%. The nature of the cathode is of the greatest moment. It should be of a metal of high hydrogen overvoltage corresponding to that of chromium. Nickel is the material mostly used now, but is far from ideal. For many purposes copper is a far better undercoating. It is impossible to increase materially the throwing power of chromic acid solutions. The best way to improve upon existing conditions is to increase the plating range in which bright plate is obtainable. Except in the case of copper, little success has been obtained from chromium deposits direct on the base metal. This may be due to the inherent porosity of these deposits. Direct deposits can be improved by heat treatment, but this does not lend itself readily to commercial practice. (7a)

A Study of Silver Plating Solutions. B. EGEBERG & N. PROMISEL. *American Electrochemical Society, Preprint* 59–32, April 1931 meeting, 19 pages.

A discussion is given of the effects of temperature, current density and concentrations of silver, cyanide, carbonate and carbon disulphide on the resistivity, throwing power and cathodic and anodic polarization in argento-cyanide plating solutions. Curves are given to illustrate these effects. A comparison is made between solutions containing sodium salts and those containing potassium salts, and the advantages of the latter pointed out. Optimum plating conditions and compositions for above solutions are suggested. The subject is treated mainly from the industrial standpoint, although theory is also briefly considered where possible. (7a)

The Electrodeposition of Tungsten from Aqueous Solutions. COLIN G. FINK & FRANK L. JONES. *American Electrochemical Society, Preprint* 59–27, April 1931 meeting, 21 pages.

A method has been developed for the electrodeposition of metallic W from aqueous solutions. The W deposit is smooth, hard and coherent, having a high luster. Like Cr, the electrodeposited W needs no polishing if the plated article was previously polished. W has remarkable acid-resisting properties, which make it desirable as a protective coating for other metals. Several types of solutions have been investigated in regard to their usefulness as W plating baths. Solutions of W salts in organic solvents were found unsuitable for this purpose. Aqueous solutions of an acid nature did not give satisfactory metal deposits. Alkaline solutions containing alkaline tungstates were preferably used as plating baths. The temperature, cathode current density and hydrogen ion concentration of the solution must be controlled. Alloys of W and Fe, and of W and Ni, were electrodeposited from similar solutions containing very small concentrations of the ions of these second metals. The usefulness of highly alkaline solutions as plating baths for the electrodeposition of other metals is pointed out. (7a)

The Electrodeposition of Silver-Cadmium Alloys. COLIN G. FINK & BASIL G. GERAPOSTOLOU. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, pages 562–563.

Part 2. Conclusion of a paper presented before American Electroplaters' Society at Washington, July 2, 1930. Authors conclude that from experiments conducted following results were obtained: (1) Increase of metal ratio Cd/Ag in bath increases metal ratio Cd/Ag in the deposit; (2) increase in current density increases Cd % of deposit; (3) increase of temperature decreases Cd content of deposit and makes it brittle; (4) increase in free cyanide decreases cathode efficiency; (5) agitation hastens anode corrosion and decreases Cd content of deposits; (6) increase in Cd renders deposits hard and brittle; (7) microstructure shows heterogeneous mixture of at least two constituents; (8) low Cd deposit is not better than pure Ag for tarnish resistance. VSP(7a)

A Silver-White Alloy Plate. COLIN G. FINK & KIHOUGH H. LAH. *Monthly Review, American Electroplaters' Society*, Vol. 18, Jan. 1931, pages 29–34.

Includes discussion. See "The Deposition of Nickel-Cobalt Alloys," *Metals & Alloys*, Vol. 1, Dec. 1930, page 910. (7a)

Electrodeposition of Chromium-Iron Alloy. G. FUSEYA & K. SASAKI. *American Electrochemical Society, Preprint* 59–23, April 1931 meeting, 15 pages; *Journal Society of Chemical Industry*, Vol. 33, Nov. 1930, pages 474B–482B.

Experiments were performed to find the best conditions of electrodepositing chromium-iron alloys containing more than 16% chromium. A chromic acid bath for chromium plating, with iron salts added, did not give any good deposit of the alloy, and, therefore, sulphate baths containing from 52 to 130 g./l. Cr, 7 to 30 g./l. Fe and 0.05 to 0.1 molar in H_2SO_4 were electrolyzed between Cu cathodes and magnetite anodes. It was found that the longer the duration of electrolysis the lower the Cr content of the deposit. The higher the current density, and the lower the temperature or the acidity of the bath, the higher the Cr content of the deposit. A search of the literature indicated that no previous work had been done on the electrodeposition of this alloy. MB(7a)

The Limiting Current Density in the Electrodeposition of Noble Metals. S. GLASSTONE. *American Electrochemical Society, Preprint* 59–12, April 1931 meeting, 8 pages.

The literature of electrochemistry does not appear to contain a simple equation permitting the calculation of the maximum, or limiting, current density at which a metal can be deposited with 100% current efficiency. Such an equation is now developed on the assumption that the maximum rate of deposition is equal to the maximum rate at which the ions containing the metal to be deposited can diffuse up to the cathode. The values calculated in this manner are shown to be in good agreement with those observed, although discrepancies may arise when there is a possibility of hydrogen evolution. (7a)

Electroplating—Recent Developments and Future Prospects. COLIN G. FINK. *Iron Age*, Vol. 127, Jan. 1, 1931, pages 48–49.

The outstanding electroplating metal is Cr. Cr plating has been resorted to on 3 counts: (1) as protective coating guarding underlying metal against corrosion; (2) used for decorative purposes; (3) used for special purposes such as rubber molds and special bearings. Zn and Cd for plating will be superior to either metal alone. Several alloys can now be successfully electrodeposited, for instance, Fe-Ni, Cu-Ni, Au-Ni, Pb-Ag, etc. New electrolytic cleaning process developed by the Bullard Co. Research activities are greater at present than ever before. VSP(7a)

Chemicals—Their Functions in Electroplating. L. C. PAN. *Brass World*, Vol. 27, May 1931, pages 79–81.

The metal compound, the conductor, the anode depolarizer, the brightening agent, and the buffer—the parts they play in electroplating solutions are briefly discussed. WHB(7a)

Recent Electroplating Literature. A. K. GRAHAM. *Metal Industry*, New York, Vol. 28, Nov. 1930, pages 524–526; Dec. 1930, pages 558–561.
Gives abstracts of papers published on various phases of electroplating in the U. S. and in England. VSP(7a)

Some Experiments on the Electrodeposition of Gold from Alkaline Cyanide Solutions. E. T. DUNSTAN. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, pages 295–297.
Text of paper read before Chemical, Metallurgical & Mining Society of South Africa. See *Metals & Alloys*, Vol. 2, May 1930, page 101. PRK(7a)

The Electrodeposition of Zinc on Aluminium from Sulphate Solutions. H. C. COCKS. *Transactions Faraday Society*, Vol. 26, Sept. 1930, pages 517–526.
Measurements have been made of the deposition potential of zinc in zinc sulphate solutions, with and without addition agents (1) with current density, (2) with pH of the solutions as the only variable. The use of buffered zinc sulphate solutions for the plating of aluminum on a commercial scale is suggested. Suitable electrolytes are:
N.$ZnSO_4$, 0.25 N. NaAc, 1 g./l. gum arabic, 0.1 g./l. *beta*-naphthol.
N.$ZnSO_4$, 0.25 N. NaAc, 1 g./l. gum arabic.
The paper is illustrated by two tables and one diagram embodying a number of curves. OWE(7a)

Electrodeposition of Platinum, Palladium and Rhodium. W. KEITEL & H. E. ZSCHIEGNER. *American Electrochemical Society, Preprint* 59–14, April 1931 meeting, 3 pages.
The chloride plating bath for Pt metals is not satisfactory due to its short life. A new bath was accordingly developed in which the Pt is present as the di-amminonitrite. Good, bright adherent deposits are obtained. The throwing power is very good. A similar bath for Pd was likewise developed and has given very satisfactory results. (7a)

Introduction of Iron into Alkaline Cleaning and Plating Solutions. E. J. LISCOMB. *Monthly Review, American Electroplaters' Society*, Vol. 18, Jan. 1931, pages 17–29.
Includes discussion. See "The Contamination of Solutions," *Metals & Alloys*, Vol. 2, Jan. 1931, page 8. (7a)

Mechanical Plater for Chromium. *Brass World*, Vol. 27, Apr. 1931, page 82.
At the Mansfield, O., plant of the Westinghouse Electric and Manufacturing Co. a conveyor type mechanical plating machine has been installed by Frederic B. Stevens, Inc., Detroit, Mich. The tanks are grouped in oval arrangement, a conveyor mechanism running above them supported on a structural steel support member. The manufacturers claim the machine to be universal and that any kind of plating or cleaning operations can be handled in it by rearrangement of sequences. The absence of overhead construction is an advantage. WHB(7a)

Electroplaters' and Depositors' Technical Society Annual Election and Round Table Discussion. *Metal Industry*, London, Vol. 37, Aug. 8, 1930, pages 129–130, 180, 182.
Meeting was devoted to the annual election of committee and officers, followed by round table discussion of methods of nickel plating P-bronze and Ni-Ag and other problems on electroplating. VSP(7a)

Electrodepositing Lead-Thallium Alloys. COLIN G. FINK & CLARENCE K. CONARD, JR. (Columbia University). *Metal Industry*, N. Y., Vol. 29, Mar. 1931, pages 116–117.
A good deposit of an alloy of 70% Pb and 30% Th was obtained on brass, using a perchlorate solution of 30 g./l. thallium, 5 g./l. lead, 20–30 g./l. free acid and a current density of 5 amps./ft.^{2} at 25° C. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. PRK(7a)

The Conductivity of Strong Electrolytes. RICHARD E. PAUL. *Chemical Engineering & Mining Review*, Vol. 23, Jan. 5, 1931, pages 157–160.
A summary of a lecture read before the Melbourne University Chemical Society, Oct. 22, 1930. Strong electrolytes do not show quantitative agreement with the theory of electrolytic dissociation. This is best explained most satisfactorily by the theory of inter-ionic attraction, which supplements rather than displaces the older dissociation theory. The fundamental idea of the inter-ionic attraction theory is that owing to the electrical attraction between the positive and negative ions, there are in the neighborhood of any ion, more ions of unlike sign than of like sign, and that when a solution is diluted, the separation of the ions involves doing internal work against this electrical attraction. Modification of the inter-ionic attraction theory of Debye and Huckel, by Onsager has made possible a complete explanation for changes in conductivity of very dilute solutions. The electrolytic conductivity is governed by two factors—the mobility change as predicted by Onsager's equation and the degree of dissociation which varies in agreement with the mass action law. At higher concentrations Onsager's equation does not remain valid and additional factors exert an influence. Among these are viscosity of the solution and the possibility of complex ion formation. For more concentrated solutions, an empirical extension of Onsager's equation is: $\lambda\eta_2 = \lambda_0 - (0.224\lambda_0 + 50.5)f(c)$, where λ represents the viscosity and $f(c)$ is a function of the concentration. While not extremely accurate, it permits an estimate of the effect of inter-ionic forces at moderate concentrations. WHB(7a)

Present Position of Chromium Plating. *Iron & Coal Trades Review*, Vol. 120, Feb. 7, 1930, page 238.
Abstract report of the discussion at the Electroplaters' and Depositors' Technical Society's meeting, London, Jan. 31, 1930. Rather brief discussion of some of the problems and practices of the industry, including relation of current density and luster, defects, adhesion of nickel, temperature control, effect of the thickness of the deposit and suggests the trial of cadmium as an undercoat. RHP(7a)

Nickel Plating Alloyed to Aluminium. E. SMITH & C. A. VELARDE. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, pages 297–298.
The following patented process is used to obtain on aluminum an adherent nickel plate which can be highly polished and even chrome plated: (1) obtain a smooth surface free of pit holes. (2) Dip in strong potash solution until gassing freely (potash 1 oz., water 1 gal.) and wash. (3) Dip in bright dipping acid (nitric 11½%, sulphuric 57%, water 31½%) and wash. (4) Nickel plate for 30 min. (nickel sulphate 3½ lbs., nickel chloride 1 oz., sodium chloride 3 oz., water 1 gal.; C. D. 15 amps./ft.^{2}, 80–90° F., pH 5.6). (5) Heat at 900° F. for 10–15 min. The plating solution must be carefully filtered and good electrical contact must be made with the aluminum. PRK(7a)

On Some Properties of Chromic Acid Baths. (Ueber einige Eigenschaften der Chromsäurebäder.) E. DE WINEWARTER. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 205.
Summarizes a paper delivered at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. EF(7a)

Buffering the Nickel Solution. OLIVER P. WATTS. *Monthly Review, American Electroplaters' Society*, Vol. 18, Mar. 1931, pages 4–11.
Practical hints. The author believes that of the various buffers so far tested the acetate seems more promising for the nickel solution under ordinary conditions of operation. The discussion of the paper brought out many and varied points. MFB(7a)

Gold Plating Solutions in Practice. (Mitteilungen aus der Praxis über Goldbäder.) HANS HORNAUER. *Deutsche Goldschmiede-Zeitung*, Vol. 34, Apr. 11, 1931, pages 156–157.
A discussion of methods used in gold plating. Either cold or hot solutions can be used. In plating such articles as cups care must be taken to obtain a good deposit on the inside. Either soluble or insoluble anodes can be used. The color of the deposit can be changed by changing the current density or by the addition of a metallic salt to the electrolyte. The compositions of several plating solutions are given. A high current density gives dark gold, and a low density light gold. Cu and its alloys can be directly plated, but other materials must first be Cu plated. Cu in the electrolyte produces a reddish tinge; Ag a greenish deposit; As a dark green tint; and Cu together with Ag a rose tint. $K_3Fe(CN)_6$ in a solution produces a rose colored gold. The Au can be recovered from electrolytes by Zn dust. JLG(7a)

Copper Plating of Aluminum for Contact Purposes. (Verkupferung von Aluminium für Kontaktzwecke.) H. GINSBERG. *Aluminium, Hauszeitschrift der V. A. W. Erftwerk*, Vol. 2, Apr. 1930, pages 24–27.
Tests have been made to determine the behavior of copper plated aluminum contacts for which a special method is described to obtain a good adhesion of the copper to the aluminum. For this purpose, an artificial oxide film is first deposited. Technological and electrical test results show the advantage of this copper plating method. In average cases, contact resistance was found to be 2 to 3 times greater than that of bare copper. The applied pressure was 4 kg./mm.^{2} and the overlapping 14 times the thickness of the bar. Another good result was obtained by first depositing zinc and then the copper on the zinc. The compositions of the electrolytes for pretreatment and plating are given. Ha(7a)

New Copper Refinery at Montreal. *Metal Industry*, London, Vol. 38, Apr. 3, 1931, page 360.
The first refined copper from the new plant of the Canadian Copper Refineries, Ltd., is expected to come on the market in April. The capacity of the plant is 75,000 tons per year. The concentrated slimes will be sent to the U. S. for final treatment. PRK(7b)

The Causes and Prevention of Cloudiness in Chromium Plating. L. R. GRIFFITHS. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, page 298; discussion in Vol. 38, Mar. 27, 1931, page 335.
Experiments showed that the appearance of cloudy patches on chromium plated surfaces is due to uneven distribution of polishing grease over the nickel surface. The high current density areas of nickel plated work are coarse grained and retain more grease from polishing wheels than other areas. The remedy is to increase throwing power of nickel plating solution by lowering current density. The cloudiness which appears on re-chromium plating may be prevented by anodic etching of nickel plate in sulphuric acid and repolishing the nickel. PRK(7a)

Chromium Plating Methods in the Noble Metal Industry. (Verchromungsverfahren in der Edelmetallindustrie.) RALPH W. HARBISON. *Deutsche Goldschmiede-Zeitung*, Vol. 34, Aug. 1, 1931, page 325.
A discussion of the use of chromium plating as applied to jewelry, and methods for plating used in America. JLG(7a)

Electrode Potentials of Silver in Cyanide Solutions. COLIN G. FINK & G. B. HOGABOOM. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, page 724.
Abstract of paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 797. MS(7a)

Electrometallurgy (7b)

The Electrodeposition of Tin. E. O. JONES. *Tin*, Apr. 1931, pages 3–6.
This is a brief survey of electroplating and electrolytic refining of tin and of tin recovery from waste. Various processes are described and their difficulties pointed out. Ha(7b)

Further Contributions to the Knowledge of the Electrolysis of Ternary Alloys. (Weitere Beiträge zur Kenntnis der Elektrolyse Ternärer Legierungen.) ROBERT KREMANN & HARALD SCHEIBEL. *Monatshefte für Chemie*, Vol. 57, Mar. 1931, pages 241–252.
The apparatus and procedure for these tests was the same as described by the authors in *Monatshefte*, Vol. 56, pages 71 and 526. Three Sn-Cu-Bi alloys, containing 2.49, 10.64 and 20.82% Bi were electrolyzed at 1000° C. with 2.8 to 6 amps./mm.^{2} using iron electrodes. Bi and Sn have a tendency to migrate toward the anode, Cu toward the cathode. The relative effect on Sn and Cu is increased with the higher Bi contents. Sodium amalgams containing 0.52 to 4.79% Sn were electrolyzed for 20 hours at 240° C. with 6 amps./mm.^{2} The relative effect of Na migrating to cathode is increased with the higher Sn contents. CEM(7b)

Investigation of Anodes for Production of Electrolytic Zinc, II. H. R. HANLEY, C. Y. CLAYTON & D. F. WALSH (Missouri School of Mines). *American Institute of Mining and Metallurgical Engineers, Preprint* 1931, 5 pages.
The effect of additions of Ca, Ag, Tl and Sn on the anode potential and stability of Pb anodes was studied. The addition of Tl plus Ag to the Pb-Ca anode increased the stability but neutralized the effect of Ca on the anode potential. JLG(7b)

Minimum Voltage to Reduce Aluminum Oxide. ALBERT BROADUS NEWMAN & GEORGE GRANGER BROWN. *Industrial & Engineering Chemistry*, Vol. 22, Sept. 1930, pages 995–1000.
The specific heat of alumina has been determined and the minimum theoretical voltage required to reduce alumina to molten aluminum and gaseous oxygen has been computed. Allowing for the lowering of this voltage in commercial practice through the use of carbon anode, the theoretical minimum voltage at 950° C. is computed to be 0.947. 16 references. MEH(7b)

The Separation of Ytterbium by Electrolytic Reduction. Observations on the Rare Earths. XXXVI. ROBERT W. BALL WITH L. F. YNTEMA. *Journal American Chemical Society*, Vol. 52, Nov. 1930, pages 4264–4268.
Bivalent ytterbium sulphate may be precipitated from an acid solution by electrolytic reduction in the presence of the sulphate ion. Arc spectrum analysis indicates that ytterbium of 98% purity may be separated in one operation from mixed ytterbium group material containing 2% ytterbium. Analysis of the precipitate showed it to be of variable composition approaching the formula $YbSO_4.xH_2O$. It is a very light green crystalline compound, soluble in dilute acids with the evolution of hydrogen and in nitric acid with evolution of oxides of nitrogen. The Yb ion is green. MEH(7b)

The Electrolytic Reduction of Acid Solutions of Molybdenum. (Ueber die elektrolytische Reduktion saurer Molybdänlösungen.) F. FOERSTER, F. FRICKE & R. HAUSWALD (Technische Hochschule, Dresden.) *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 146, Feb. 1930, pages 81–100, 177–231.
The electrolytic behavior of Mo^{IV}/Mo^{V} and of Mo^{V}/Mo^{III} solutions was studied and the reduction potentials at the cathode occurring during the electrolytic reduction process $Mo^{IV} \rightarrow Mo^{V}$ and $Mo^{V} \rightarrow Mo^{III}$ in HCl and H_2SO_4 solutions of various concentrations are compared. Especially for Pt and Au cathodes, the potential course proved to be materially different from a reversible one, which is only influenced by concentration polarization. The authors discovered the formation of diaphragms of changing properties at the cathode. Deductions from this observation are set forth, leading to new viewpoints concerning electrolytic reduction processes. EF(7b)

INDUSTRIAL USES & APPLICATIONS (9)

The Use of Zinc and Zinc Alloys in the Automotive Industry. ROBERT M. CURTS. *S. A. E. Journal*, Vol. 28, April 1931, pages 447–462; *American Metal Market*, Vol. 38, Jan. 30, 1931, page 13; Jan. 31, 1931, pages 5, 10; Feb. 3, 1931, pages 3, 5; Feb. 4, 1931, pages 5, 10; *Iron Age*, Vol. 127, Feb. 19, 1931, pages 622-626.

A brief review of the part that Zn and its alloys have played in the past and a discussion of recent developments in Zn-base alloys which have enhanced their field of use in the automotive industry. Features covered include: electro-zincing, rolled Zn and rolled-Zn alloys, Zn wire, extruded Zn shapes, die-castings, Zn alloys for body hardware and other equipment, Zn-Al alloys, heat treatment of Zn base alloys, physical properties of die-casting alloys, cleaning, etching and Ni plating processes for Zn die-castings. Cd plate may be applied directly with no appreciable harmful effects. Attractive coats of enamels, japans and lacquers may be applied to Zn and its alloys. Metallic Zn is used in the automotive industry for electro-galvanizing, as a constituent of brass, as rolled sheet and strip for a variety of fabricated products and in the production of a great number of die-cast parts. The physical properties of the various alloys and the ease of application of attractive and durable plated finishes have resulted in annual increases in the Zn consumption for automobile parts. Tables show the A. S. T. M. specification B 6–18-Spelter and the physical and electric properties of a Zn die-casting alloy containing 4% Al, 3% Cu, 0.5–1.0% Mg and the balance Horsehead special Zn. WHB(9)

Metal Aircraft Production. *Automobile Engineer*, Vol. 20, July 1930, pages 245–248.

Corrugated design is required to secure maximum strength and minimum weight. Greater strength with less weight can now be had with metal than with wood but so far the cost has been greater for the metal. An attempt to standardize sections so that they may be used in more places is being tried by Boulton & Paul, Ltd. Equipment is designed to handle either steel or duralumin. Largely a description of plant equipment. RHP(9)

The Use of Austenitic Steels for Motor Valves. (L'emploi des Aciers austenitiques pour les soupapes de motoeurs à explosion.) *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Feb. 1931, pages 106–108.

General discussion of austenitic steels. GTM(9)

Brass, Bronze and Other Copper Alloys for Spring Making. *The Mainspring*, published by The Wallace Barnes Co., Jan. 1931, pages 4–6.

A non-technical discussion which, however, includes useful tables. MFB(9)

Casting for Bronze Gears. Part II. FRANCIS W. ROWE (David Brown & Sons). *Metallurgia*, Vol. 3, Feb. 1931, pages 144–146.

Only Sn and Sn-P bronzes have been found to be universally suitable for heavy duty gears. The bronze used in gears should have a low coefficient of friction, and a high resistance to wear. Discusses mechanical properties required of good bronze gears. JLG(9)

The Trend of Aluminum. *Metal Industry*, N. Y., Vol. 29, Apr. 1931, page 166.

The use for aluminum will grow mainly by its extension into the building industry, its use in electrical work and by the expansion of the transportation industry. PRK(9)

The Aluminum Contact. (Der Aluminiumkontakt.) HANS SCHMITT & B. WULFF. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Apr. 1930, pages 28–33.

A very exhaustive investigation into the electric resistance of metallic contacts with reference to pressure, surface area and nature of the surface. Copper and aluminum bars of 40 × 6 mm. were compared. It was found again that, for aluminum bars, the contact resistances at a certain pressure became greater, the more smoothly the surface was prepared, and that an application of a rough file just before the contact is made gave the best results. A slight coating with vaseline and the use of emery paper is good. For coppered aluminum contacts, the best results were obtained for copper deposited on a zinc plated bar. Ha(9)

Aluminum as a Roofing Material. E. S. WOODWARD. *Sheet Metal Worker*, Vol. 22, Feb. 6, 1931, pages 71–72.

General discussion on the application of aluminum as roofing material. GN(9)

Air Transformers with Aluminum Windings. (Lufttransformatoren mit Aluminiumwicklung.) UNGER. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, June 1930, pages 84–90.

An experimental transformer is described with windings of aluminum and aluminum oxide insulation and impregnated with kaolin enamel. The transformer could stand very high overloads. The heat radiation of the coil was held at 0.116 watts/cm.^{2} Ha(9)

The Use of Aluminum in Switching Installations. (Die Verwendung von Aluminium in Schaltanlagen.) SCHMITT. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Apr. 1930, pages 3–18.

Aluminum as material for bus bars and transmission lines has already found a very wide application. Several examples of European and American installations are illustrated. The respective advantages of aluminum over copper are discussed in detail with respect to mechanical stresses due to weight and short-circuits, heating by normal current, skin effect, heating by short-circuit currents and safety against arcing. Contacts between aluminum bars should be pressed together with about 2–3 kg./mm.^{2} and the current density not be more than about 0.1 amp./mm.^{2} Aluminum bars, pipes and wires can now be welded very satisfactorily. The best method is autogenous welding; as a flux, Autogal and Firinit are recommended. The economy to be realized by the use of aluminum of equivalent conductivity of copper is a saving of 47% in price, taking the cost of 222 RM/100 kg. Cu and 238 RM/100 kg. Al (in bars) at the time of the writing of the paper. The costs for installations are about the same; the behavior at short-circuit with respect to heating, better; and, for long transmission lines, great savings can be made in supporting towers. Ha(9)

Rolled Gold: Its Origin and Development. ERNEST A. SMITH. *Metal Industry*, London, Vol 37, Sept. 19, 1930, pages 275–276; Sept. 26, 1930, pages 299–301; *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 175–205.

Deals briefly with the history of the rolled-gold industry. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 912. VSP(9)

The Use of Nickel in the Electrical Industry and in Electrodeposition. (Die Anwendung des Nickels in der elektrischen Industrie und Galvanotechnik.) M. BALLAY. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, pages 204–205; *Revue du Nickel*, Vol. 2, Jan. 1931, pages 2–15.

Brief reference to the paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, June 1930. EF(9)

Aluminum Tank Cars for the Chemical Industry. (Aluminium Kesselwagen für die chemische Industrie.) BUSCHLINGER. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Nov. 1930, pages 218–221.

For the transport of concentrated nitric acid, ammonia water, formaldehyde and liquid motor fuels, aluminum tank cars of sufficiently thick plates which are welded together permit the carrying of a greater useful load for the same total weight. In cases where formerly earthenware tanks were used on railroad cars and caused heavy damage by breaking, aluminum has been substituted to great advantage. Motor trucks and railroad cars are illustrated. Ha(9)

Aluminum and Aluminum Alloys as Materials in the Chemical Industry. (Aluminium und Aluminiumlegierungen als Baustoffe in der chemischen Industrie.) DR. DORNAUF. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Nov. 1930, pages 196–217.

Numerous illustrations of all kinds of apparatus used in chemical plants. Ha(9)

Light Metal Construction in Transportation. (Leichtmetallbau im Verkehrwesen.) FRITZ GENTZCKE. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Sept.-Oct. 1930, pages 135–157.

This paper deals fairly exhaustively, though in a general way, with the properties of high grade light metals and their possible economical application in industry and technique. Constructions and new ideas, especially, are discussed for the use of vehicles of all kinds; comparisons with other structural materials are made. Many diagrams and tables show the mechanical and physical properties of the most-used light metals. Methods of working, selection of construction elements, treatment of surfaces are described and critically compared. The economy is thoroughly treated and rentability calculations, especially for transportation, are made. Many illustrations show details of construction of motor coaches, buses and other vehicles and, also, of construction parts. Ha(9)

Experiments with Ladder Rungs of Wood and of Lautal. (Versuche mit Leitersprossen aus Holz und aus Lautal.) M. P. A. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Sept.-Oct. 1930, pages 157–158.

For the use of lautal as material for rungs of 5 ladders, tests showed superiority over rungs of ash wood. In a flame of 850–900° C. up to 40 sec., the wood became entirely useless, while the lautal rungs, made of hollow profile 12 × 25 × 0.75 mm., showed only slight bending with a sag of 1.2 mm. in a length of 250 mm. The weights were 57 g. for wood and 48 g. for lautal. Ha(9)

Hard-Facing Metals—Their Applications. R. L. LERCH. *Welding*, Vol. 1, July 1930, pages 613–615.

Materials of red hardness are now successfully used to build up worn parts. A long list of various uses is given. The welding on of such materials usually results in a great economy. Ha(9)

Comparison of Weights of 17ST and Steel Tubular Structural Members Used in Aircraft Construction. E. C. HARTMANN (Aluminum Company of Am. Research Labs.). *Technical Note* No. 378, National Advisory Committee for Aeronautics, May 1931. 17 pages, 5 figures.

If it is permissible to have a larger outside diameter in the 17ST (Duralumin) tube, a tubular structural member designed for a 92,000 yield point steel can be made of equal strength in 17ST at a weight saving of 10 to 40%. For long columns and beams designed for a given deflection, the 17ST is 39% lighter. If the steel has a yield point of 115,000, the 17ST loses some of its advantage for tension members and short columns, and if the outside diameter is fixed at that of the steel tube, the steel will be the lighter. Detailed calculations and plots are given upon which these conclusions are based. HWG(9)

The Use of Nickel in Automobile Engineering. J. B. HOBLYN. *Automobile Engineer*, Vol. 20, Sept. 1930, pages 339–340.

Summary of uses in various parts. Chassis, 3% Ni, C 0.15–0.20% increases strength without sacrifice of ductility. Shackle bolts, 3–5% nickel case hardening steel, C not over 0.15%. Front axle, 0.4% C, 1% Ni, water hardened. For highly strained axles, add ¾% Cr. Rear axle, 3% Ni-Cr steel, oil hardened. For heavier vehicles, 4.25% Ni, 1.25% Cr, 0.28% C, air hardened. Gears, 3–5% Ni or 3% Ni-Cr steel, case hardened, 1½–3½% Ni-Cr, oil hardened. Cylinders, 3.5% and up of Ni. Valves, 20% Ni-Cr steel. RHP(9)

Alloys of Aluminum and Magnesium in Modern Construction. (L'impiego delle leghe di alluminio e di magnesio nelle construzioni moderne.) G. GUZZONI (Instituto Scientifico Technico E. Breda, Milan). *La Metallurgia Italiana*, Vol. 23, Mar. 1931, pages 177–192.

The first of a series of articles on uses of light alloys. A list of common alloys (35 Al base and 20 Mg base) is given, with trade name or number, treatment, tensile strength and elongation and brief comment on characteristic mechanical properties. Comparisons of some of these with other materials of construction such as steel, alloy steel, cast iron, Cu, brass, bronze, wood, etc., in regard to weight, elastic limit, "limit of viscosity," elastic modulus, column strength and endurance limit are given, and the usual conclusions are reached as to fitness of the light alloys for engineering uses requiring maximum properties per unit weight. Brief comment is made on airplane longeron construction. HWG(9)

Skyscraper Employs 300 Tons of Corrosion-Resisting Steel. E. F. ROSS. *Steel*, Vol. 87, Aug. 7, 1930, pages 43–46, 50.

Empire State Building utilizes 300 tons of polished 18–8 Cr-Ni steel for window trim, ornamental sunbursts, store fronts and dirigible mooring mast. Describes fabricating operations at the plant of the United Metal Products Co., Canton, Ohio. These operations include a limited amount of punching on the corners of the sheets, bending or forming, spot and seam welding, polishing of the welded joints. Due to the great hardness of the 18–8 steel, a die steel containing 1.00–1.50% Ni and 0.65–0.85% Cr is used in the forming brakes. A total spring back allowance of 15 minutes is found necessary. After fabrication, the sections are pickled in 25% HNO_3 at 120–125° F. for 20 min. Special precautions in handling and shipping are taken. MS(9)

Pure Aluminum in Electrical Industry. (Rein-Aluminium in der Elektrotechnik.) A. SCHULZE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Nov. 29, 1930, pages 1653–1654.

A review of the studies of H. Schmitt on the special suitability of aluminum in switching and power plants in which the connections and bus bars must stand mechanical stresses due to their own weight and to short-circuits, and heating by the normal current. A further question is their skin effect and alternating current resistance, joints and contact resistance and weldability. The following table shows the most important characteristic properties of pure Al and Cu for use in electric installations:

	Al	Cu
Specific gravity	2.7	8.89
Electric conductivity, hard	35.2	57
Electric conductivity, soft	36	58
Specific resistance, hard	0.02845	0.0175
Specific resistance, soft	0.02780	0.0172
Temperature coefficient	0.00408	0.00393
Specific heat	0.214	0.0933
Heat conductivity, cal./cm./sec./degree	0.5	0.8–0.9
Melting point ° C.	658	1083
Fusion heat, kcal./kg.	100	43.3
Tensile strength, hard kg./mm.^{2}	18–25	30–35
Tensile strength, semi-hard kg./mm.^{2}	11–13	28–30
Modulus of Elasticity	630–750,000	1,300,000
Linear expansion coefficient	0.000027	0.00001698

The advantages of Al in certain cases are pointed out and tests have shown that for a given large short-circuit energy, Al is more economical. Joints are often coppered to reduce the contact resistance. Ha(9)

HEAT TREATMENT (10)

Effect of Heat Treatments on Efficiency of High-Speed Steels. ERDMANN KOTHNY. *Iron Age*, Vol. 126, Dec. 18, 1930, pages 1848–1852.

Translated from *Maschinenbau*. Describes tests carried out: (1) to test correctness of Oertel and Pölzguter's contention that effect of tempering on cutting efficiency diminishes as alloy percentage rises; (2) to determine influence of tempering when different hardening temperatures are used; (3) to prove influence of tempering when machining very hard and medium hard steel. Results show that cutting efficiency of high-speed steels, working on hard and medium steels, can be increased by tempering at 590° C. Investigations also cover the influence of tempering at 350° C. Contains numerous illustrations. Tabulates results of tests. VSP(10)

The Heat Treatment of Aluminum Alloys. ROBERT J. ANDERSON. *Metals & Alloys*, Sept. 1930, pages 721–726; Oct. 1930, pages 775–780.

A review. Bibliography of 55 references. ESC(10)

Heat Treatment of Aircraft Engine Parts. R. R. MOORE. *Fuels & Furnaces*, Vol. 9, Mar. 1931, pages 279–289.

Outlines importance of proper heat treatment and describes methods of heat treating steel and Al alloy parts. Tabulates chemical composition and physical properties of the Al alloys. See *Metals & Alloys*, Vol. 2, May 1931, page 103. MS(10)

Effects of Prequench Treatments on Hardened Tool Steel. R. H. HARRINGTON. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1363–1364.

Abstract of paper read before the American Society for Steel Treating. MS(10)

Heat Treatment of Delicate Tools of High Speed Steel. SAM TOUR (Lucius Pitkin, Inc.). *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1251–1256, 1258.

Study of the recommended practice of the American Society for Steel Treating for heat treatment of 18% W high-speed steel indicates that in the ordinary methods of heat treating to 2400° F., blistering, pitting, scaling, etc., results, and excessive grain growth is liable to develop. An electric furnace has recently been developed in which heating is by radiation and in which the atmosphere is practically stationary and made up of products of combustion of gas and air accurately controlled to give a true neutral atmosphere. Small intricate tools heated to 2350–2400° F. in the furnace showed no evidence of scaling, pitting, carburization or decarburization. It was not necessary to grind the surface after heat treatment. To test the question of excessive grain growth, samples 1 in. long and 1/2 in. diameter were prepared. Three were preheated at 1600° F. in an oxidizing atmosphere, transferred to the high heat of 2400° F., oxidizing atmosphere, and held for 1 1/4, 2 1/2 and 5 min., respectively. Four were preheated at 1600° F. in a neutral atmosphere, transferred to the high heat of 2400° F., neutral atmosphere, and held for 1 1/4, 2 1/2, 5 and 10 min., respectively. All were quenched in oil at 250° F. Microscopic examination showed that there was no appreciable grain growth in either atmosphere after 1 1/2 min. For the longer exposures, there was a greater amount of grain growth in the oxidizing atmosphere, this being decidedly so for the 5-min. sample. The one soaked for 10 min. in the neutral atmosphere did not show excessive grain growth. MS(10)

Hardening (10a)

The Mechanism of the Hardening of Steel. (Ueber den Mechanismus der Stahlhärtung.) G. KURDJUMOW & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 70–78.

On the quenching of carbon steel from the γ field, some face-centered cubic γ crystals remain, the rest changes to an instable tetragonal phase which differs little from the body centered cubic α crystals, but which can hold carbon in solid solution. In order to produce a large austenite crystal a 1.4% C steel was melted in an alumina crucible of 10 mm. diameter, 70 mm. long, the crucible chilled at one end to start freezing, the furnace temperature lowered to 1100° C., held for 1 1/2 hours and the steel then quenched in water. The specimen was piped, brittle and contained large crystals of martensitic structure, from which specimens were ground out and etched, for X-ray study. This showed relationships as follows:

Tetragonal Phase to Austenite		Alpha Iron to Austenite	
(011)	(111)	(011)	(111)
[1$\bar{1}$1]	[10$\bar{1}$]	[1$\bar{1}$1]	[10$\bar{1}$]
(001) 9° from	{100}	(001) 10.5° from	{100}
(100) 4.5° from	{110}	(100) 5.5° from	{110}
(010) 8° from	{110}	(010) 10° from	{110}

The change of the tetragonal to the α phase by simple gliding through the small angles and tiny distances required, and accompanied by a contraction of the lattice from 2.51 to 2.48 A. U. is shown by diagrams, and many X-ray photograms are reproduced. The transformation of the tetragonal phase to the α on heating at 100° was followed by the X-ray method. About 40% is transformed in 1/2 hour, 65% in an hour and 95% in 2 hours. The authors do not venture to decide, on the basis of their X-ray observations, whether the hardness of martensite is due to small crystal size or to internal stress. See also *Metals & Alloys*, Vol. 2, Mar. 1931, page 69. HWG(10a)

Hardening Crown Gears. *Automobile Engineer*, Vol. 20, Sept. 1930, pages 325–326.

Description of an apparatus designed by W. Ferd. Klingelnberg Söhne. The work rests upon a fixed support between dies which are hydraulically pressed together and a flood of oil cooled for hardening and having a uniform temperature is forced across all parts to be quenched with a constant velocity. Claim is made that this prevents distortion such as is apt to occur when the gear is quenched by dipping. RHP(10a)

Annealing (10b)

Continuous Annealing Process and the Principles of Heat Transmission. (Das Durchziehglühverfahren und die Grundlagen der Wärmeübertragung.) O. JUNKER. *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 124–125.

Stresses the annealing process of metal in strip form by continually pulling the material through the furnace. The theoretical possibilities of uniformly annealing the material over the whole length is discussed. After describing the furnaces, the author confines himself to the theoretical principles of heat transmission calculations and compares the practical results obtained with the theoretic derivations. EF(10b)

Case Hardening & Nitrogen Hardening (10c)

Localized Case Hardening Applied to Bearing. *Steel*, Vol. 87, Sept. 11, 1930, page 69.

Thompson Products, Inc., Cleveland, Ohio, carburizes the inner surface of split bearings for automobile steering mechanism by a selective method. After finish machining the bearings are Cu plated. The Cu is removed from the wearing surface, which is to be carburized, by a round cupping tool. The bearings are next carburized, then hardened in a salt bath at 1425° F. and quenched in brine. MS(10c)

On the Nitriding of Iron and Iron Alloys. I. (Ueber die Nitrierung von Eisen und Eisenlegierungen. I.) W. EILENDER & O. MEYER. *Archiv für Eisenhüttenwesen*, Vol. 4, Jan. 1931, pages 343–352; *Stahl und Eisen*, Vol. 51, Jan. 29, 1931, page 130.

Alloys of Fe with Al, Cr, Mo and V were nitrided at constant velocities of the stream of ammonia and constant temperatures. The surface hardness and the depth hardness as well as the structural changes were studied. The hardness was determined with the Rockwell machine as well as with Herbert's pendulum tester. In nitriding electrolytic iron between 200° and 1000° C., two different zones were observed below 600° C. Above 600° C., appears the eutectoid Braunit. The constant of diffusion of nitrogen was determined to be $k = 2.14 \times 10^{-8}$ cm./sec. at 550° C. The type and order of the diffusion of nitrogen seems to be similar to that of carbon. The chemistry of the process is discussed, with particular regard to the retarding influence of carbon on the nitriding process. In nitriding Fe-Al, Fe-Cr, Fe-V and Fe-Mo alloys, it was found that the surface hardness does not increase above a certain concentration of the alloying element. Aluminum alloys with 1% Al have the greatest hardness. Peculiar structures were observed in the Fe-Al alloys, resembling the rhythmic occurrences of precipitation in colloidal systems. The mechanism and chemistry in nitriding Fe-Al alloys is considered in detail. GN(10c)

Nitriding Symposium at National Metal Congress. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1381–1385.

Abstracts of papers presented at a symposium held by the American Society for Steel Treating, Sept. 22–26, 1930. MS(10c)

Carburization of Steel in a Gas Atmosphere. O. J. WILBOR & J. A. COMSTOCK. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1375–1376.

Abstract of a paper read before the American Society for Steel Treating. MS(10c)

Cementation of Aluminum. ROBERT J. ANDERSON. *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1243–1245.

Laboratory investigations of hardening the surface of Al by cementation have been successful, but no commercial process has yet been developed. Such metals as Fe, Cu, Cr, Co, Mn and Ni suggest themselves for this purpose. Chief difficulty is the formation of a film of Al_2O_3, which resists the penetration of alloying metals. Possible methods are the electrodeposition of a metal on the surface followed by heating at a temperature below the melting point of Al, and heating Al in contact with powdered metals, or gaseous or liquid metallic compounds. Most of the experimental work has been done on the first process and it is apparently the most successful to date. Cournot has done much work in this field. Possible applications of cemented Al are for corrosion-resisting purposes, e. g., in sea water and in alkaline liquors, and for articles where it would be desirable to increase the resistance of Al alloys to wear and abrasion, e. g., motor pistons. MS(10c)

Nitriding—Its Present and Future Status. V. O. HOMERBERG. *Iron Age*, Vol. 127, Jan. 1, 1931, page 52.

Outlines developments of nitriding. A new phase of nitriding is its application to surface hardening of special alloys tool steels. Nitromal, a malleable cast Fe which can be case-hardened with ammonia gas, can be made on a semi-commercial basis. Compositions of white cast Fe to give varying degrees of malleabilization have been evolved. Lists several investigations now under way at Nitralloy Corporation. VSP(10c)

Practical Suggestions on Nitriding. W. J. MERTEN (Westinghouse Elec. & Mfg. Co.). *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1235–1237.

To obtain desired uniformity, depth of case and hardness without brittleness, the structure of forgings and rolled bars is refined by heating at 1950–2000° F., soaking at a rate of 2 hrs./in. cross sectional diameter, and air cooling to a black heat. This is followed by reheating to 1550–1600° F., soaking at a rate of 1 hr./in. diameter and air cooling; then reheating to 1275° F. and furnace cooling to room temperature. Centerless-ground surface finish for cold-drawn bars is recommended for maximum hardness. Paste of SnO_2 made up with an alcoholic solution of shellac offers real protection to surfaces that are to be left soft. Charge should be so distributed in the container that there is a space of not less than 2 in. between the gas inlets and the charge. No charge should occupy the space 4 in. from the gas outlet. A maximum gas pressure of 1/4 in. Hg on a 2 in. deep Pb seal works well. Cooling the charge after processing in the closed box with NH_3 flowing, prevents discoloring and warping and results in a harder case. When testing hardness of case with the Vickers instrument care should be taken to see that the case is not pierced through. A minimum depth of 0.020 in. is required to avoid piercing through. Inlet piping must be made of Ni to avoid closing up of the perforation. Leaky joints are indicated by the formation of a white cloud of NH_4Cl when tested with a taper soaked in HCl. Case can be softened by immersing in an NH_4Cl-KCl bath at 1500° F. and allowing bath and part to cool to just above melting point of the salt mixture. Part is then taken from the bath while the salt is still liquid, the salt shaken from it and it is cooled slowly to room temperature. MS(10c)

Aging (10f)

Age-hardening of Austenite. F. R. HENSEL (Westinghouse Elec. & Mfg. Co.). *American Institute of Mining and Metallurgical Engineers, Technical Publication* No. 419, 1931, 25 pages.

Successful attempts were made to age-harden non-magnetic steels. Alloys were prepared by adding various amounts of Ti or Mo to a base alloy containing 15% Ni, 10% Mn and practically no C. The Ti alloys with a Ti content as high as 7% forged well. The Mo alloys contained as much as 15% Mo, and all forged well. Marked precipitation hardening was observed in alloys containing from 3 to 5% Ti, and in alloys containing over 13% Mo. The maximum hardness was produced by aging at 600° C. for the Ti alloys, and at 750° C. for the Mo alloys. The tensile strength of the Ti alloys increased on aging, but no increase was found in the Mo alloys even though their hardness increase was appreciable. An alloy of 12.67% Ni, 9.66% Mn, 3.96% Ti and 0.10% C had the following properties as quenched: Proportional limit 15,750 lb./in.^{2}, tensile strength 86,500 lb./in.^{2}, reduction of area 43.7%, elongation in 1 in. 36.5%, Brinell 174. After aging at 600° C. for 120 hr.: Proportional limit 25,000, tensile strength 125,500, reduction of area 8.5%, elongation in 1 in. 5.9%, Brinell 293. After aging at 550° C. the strength was slightly lower, 112,570 lb./in.^{2}, but the ductility was higher. Contains 16 references. JLG(10f)

The Artificial Ageing of Duralumin and Super-Duralumin. K. L. MEISSNER. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 207–240.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850 (10f)

Pressure-Aging of Duralumin. LEOPOLD PESSEL. *Industrial & Engineering Chemistry*, Vol. 22, July 1930, pages 776–777.

Tensile strength, elongation and hardness tests were conducted on duralumin before and after corrosion in a salt spray (20% NaCl) with samples that were aged under pressure and others aged without application of pressure. It has been shown that by the treatment given the duralumin, elongation increased appreciably in the aged specimen under pressure compared to those aged without pressure. The tensile strength and hardness showed a practically insignificant decrease. After exposure to corrosion, however, the decrease in tensile strength and elongation was much smaller in the duralumin that had been aged under pressure. The decrease in hardness due to corrosion was about the same with both methods. MEH(10f)

Sil-Fos

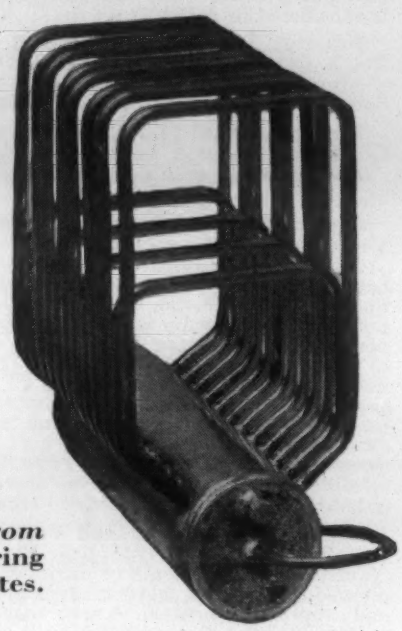
Brazing Alloy an Important Discovery

Stands 1490 Lbs. *Hydraulic Pressure*

One of America's leading refrigerator manufacturers has permitted us to photograph this evaporator unit used in testing SIL-FOS brazing alloy.

Its 29 joints, including the heavy forged brass head, were brazed with SIL-FOS in the ordinary way. Then *hydraulic* pressure was slowly applied and increased until the badly-distorted drawn brass shell finally burst, at *1490 lbs.* per sq. in.

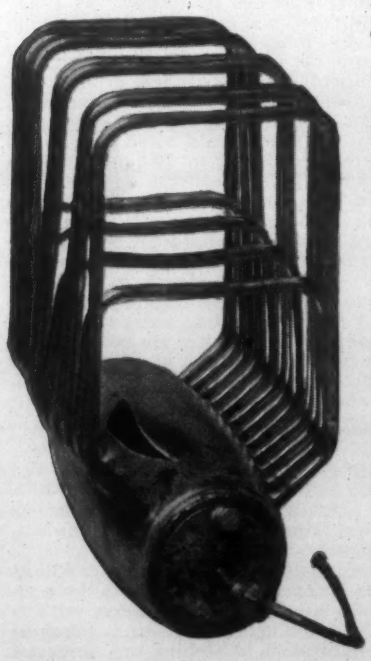
***Not a drop of water issued from any one of the 29 joints* during the test, which lasted 10 minutes.**



Normal Unit, Before Test 29 Joints Brazed with Sil-Fos

SIL-FOS

FLOWS FREELY AT 1300° F. as compared with 1600° to 2100° F. for base metal brazing alloys.



Burst at 1490 lbs. Hydraulic Pressure Yet Not a Drop of Water Issued from Any Joint

PENETRATES QUICKLY and THOROUGHLY because of its silver content.

REQUIRES LESS FLUX ON MOST METALS because of the deoxidizing effect of phosphorus in the alloy. This means time saved in brazing, and less cleaning after the joint is finished. Under certain conditions satisfactory copper-to-copper joints can be made without using any flux.

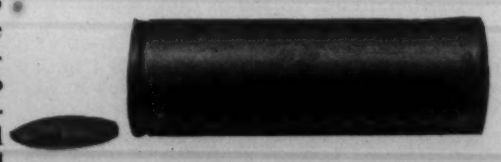
WORKS FAST and is easy to use.

MAKES STRONG JOINTS which resist shock and vibration.

BRAZES COPPER and can be used in many cases for joining brass, bronze, nickel, nickel silver, extruded brass and bronze, monel metal and other metals and alloys fusing above 1300°F.

IS SURPRISINGLY LOW IN PRICE by the pound.

Although SIL-FOS contains silver, we offer it at prices ranging from $1.25 to $3.00 per *pound*, depending on size and quantity. Produced in the customary welding and brazing rod sizes, and in thin strip.



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JOINING OF METALS & ALLOYS (11)

Possibilities of Repair of Aluminum Pieces by Soldering and Welding. (Ausbesserungsmöglichkeiten von Aluminium-Werkstücken durch Löten und Schweissen.) H. Reininger. *Die Schmelzschweissung*, Vol. 10, Apr. 1931, pages 86–88.

Proper application of soldering and welding methods can often result in considerable saving of defective aluminum or aluminum alloy pieces. Suitable aluminum solders are described and welding methods discussed; the necessary mechanical and chemical pre-treatment described. A brief comparison of all important properties of the required rigid joints assists in selecting in every case the right method of repair. Possible errors are discussed and microphotographs show the structure of the joints made in different ways. Ha(11)

Brazing (11a)

Hard Soldering (Brazing) of Cast Iron. (Das Gusseisenhartlöten.) W. Anders. *Die Schmelzschweissung*, Vol. 10, Feb. 1931, pages 30–32.

A discussion of the metallographic and physical examination of cast iron soldered with Cu-Zn alloys shows that at the joints a zone of solid solution of Fe-Zn-Cu must be formed and C oxidized to CO_2 if a solid, reliable joint is to be obtained. Failures of brazing can always be traced to improper procedure and heat treatment. A properly soldered joint possesses greater strength than the cast iron piece. Ha(11a)

Electric Resistance Brazing Affords Durable Joints. G. E. Gifford (General Electric Co.). *Steel*, Vol. 87, Sept. 11, 1930, pages 59–60.

In resistance brazing, heat is generated by passing current through a pair of C blocks with the joint clamped between them. The C blocks heat readily and the heat is conducted into the pieces being brazed. Necessary equipment consists of a transformer, leads, foot switch, and tongs for holding the C blocks. Parts to be brazed are designed with flat surfaces or are flattened before they are clamped in the tongs. Alloys containing 10–50% Ag are generally used as the brazing medium. Alloy with 10% Ag melts at 830° C., that with 30% Ag, at 735° C., and the one with 50% Ag, at 725° C. Fused $Na_2B_4O_7$ generally is used as flux but in some cases it is more satisfactory to use KHF_2 in paste form. Glazing is less likely to occur if the flux is not put on until after the work has been clamped between the C blocks. Current is applied until the flux melts. A strip of Ag alloy then is held against the hot metal until the alloy flows between the pieces being brazed. Heat should be maintained until the flux appears as a thin fluid upon the surface of the molten alloy. The tongs are not to be removed or the pressure upon them released until the joint has cooled to a dull red color. The process takes much less time than soldering and makes a smaller joint which has better physical properties. MS(11a)

Soldering (11b)

Technique in Soldering "18–8" Steel Alloys. Robert T. MacGill. *Chemical & Metallurgical Engineering*, Vol. 38, Mar. 1931, page 169.

Practical hints. MFB(11b)

New Aluminum Solder. *Welding*, Vol. 2, Apr. 1931, page 241.

It is claimed that this new solder made by the Pittsburgh Metals Purifying Corp., Pittsburgh, Pa., makes joints stronger than the metal itself. No flux is used. Beside its use for duralumin, it is alleged that it is equally good for zinc and magnesium metals. Ha(11b)

Welding & Cutting (11c)

Facts Concerning Automatic Arc-Welding. A. M. Candy. *Welding*, Vol. 1, July 1930, pages 599–601.

Automatic welding requires a much more careful preparation of the pieces than the preparation for hand welding. The advantages, limitations and speeds obtainable are discussed and a few examples given. Ha(11c)

Selected Welded Constructions. (Ausgewählte Schweisskonstruktionen.) Vol. 2, Machine Construction. (Maschinenbau.) K. Haas. V. D. I. Verlag G. m. b. H., Berlin. 1930. Cloth, $8^1/_2 \times 11^1/_2$ inches, 97 pages. Price 14.50 RM.

The second volume of this ambitious publication fulfills the promise of the first volume (reviewed in *Metals & Alloys*, Vol. 2, Jan. 1931, page 34) and is, perhaps, more interesting as it shows to how great an extent modern welding practice has influenced machinery construction, to which the present volume is dedicated. The advantages of welded constructions over castings in this field are many; among them are especially savings in making patterns, in the foundry, shorter delivery and machining time—which can sometimes even be omitted entirely—and greater variety and freedom in shaping, as molding and casting need not be considered. A great many examples show the application in making jigs, templates and other devices required for machining. A most interesting example of combining constructive necessity with utility is the frame of a portable compressor, where the supporting frame is made up of tubes which, at the same time, serve as air tanks. Lathes, planers, etc., are made in this way just as cranes, hydraulic presses and blower-wheels. Of the 97 pages, 34 give examples of American practice which shows the author's impartiality in selecting good constructions. The whole book proves that welding does not simply replace riveted or cast elements of machinery, but that new ways have been found which utilize to the full the greater flexibility and economy which this process offers. Make-up and printing are excellent, as in the first volume.—M Hartenheim (11c)-B-

The Field of Welding. E. Gossow. *Engineering Progress*, Vol. 11, Oct. 1930, pages 261–267.

Based on various articles which have appeared in the *Zeitschrift Verein deutscher Ingenieure*. A review of some of the principal uses of welding are discussed by reference to examples of steel building, bridge work, traffic equipment and pipe line welding. RHP(11c)

Electric Welding of Steel. T. McLean Jasper. *Journal of the Western Society of Engineers*, Vol. 35, Dec. 1930, pages 415–422.

General discussion of arc welding of pressure vessels. GTM(11c)

The Cause and Prevention of Heat Cracks in Aircraft Welding. H. S. George (Union Carbide & Carbon Corp.). *Preprint* for May 1931 meeting Aeronautic Div., *American Society of Mechanical Engineers*, 7 pages.

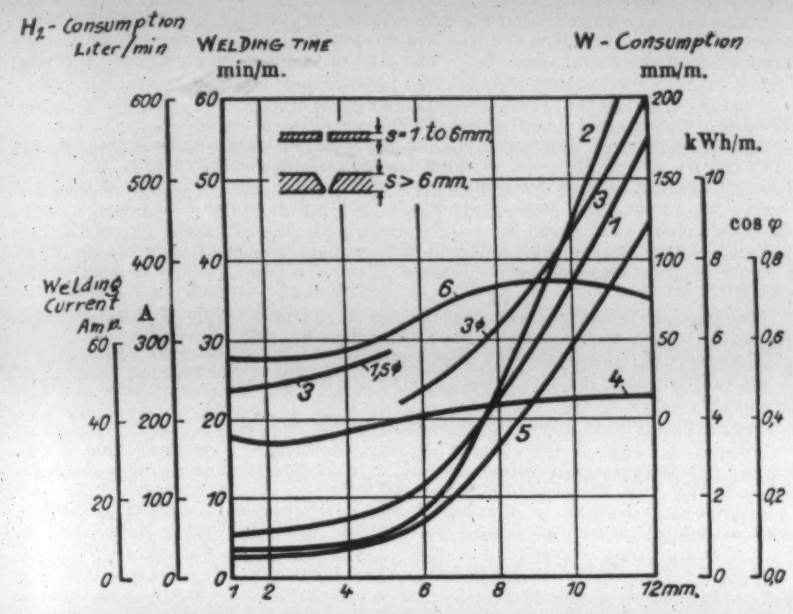
Intercrystalline edge-cracking is often met in welding, and Cr Mo steel used in aircraft construction is especially susceptible because the stresses set up are intensified by its high strength and its air-hardening tendency. Welding toward the edge tends to prevent cracking, as is explained by a consideration of the localized stresses involved. Placing the weld in slight compression by clamping, and preheating are also helpful. Cracks may also be caused by internal stresses due to straightening, etc., but these stresses can be removed by a preliminary heating to a dull red to relieve them. 19 figures are included. HWG(11c)

The Training and Testing Institute for Welding of the Austrian Azetylen-Verein. (Die Schweisstechnische Lehr- und Versuchsanstalt des Oesterreichischen Azetylen-Vereins.) Adolf Fraenkel. *Mitteilungen des Staatlichen Technischen Versuchsamtes in Wien*, Vol. 19, 1930, pages 42–48.

A detailed description of buildings and equipment of the new institute. Ha(11c)

The Development of Welding Apparatus According to the Langmuir-Process in America and Germany. (Die Entwicklung der Schweissgeräte nach dem Langmuir-Verfahren in Amerika und Deutschland.) S. SANDELOWSKY. *Elektrotechnische Zeitschrift*, Vol. 51, Nov. 27, 1930, pages 1649–1652.

This method called the "Arcatom-method" is an electric arc welding process in which the arc burns within a protective atmosphere of hydrogen carried to 2 tungsten electrodes; the gas is disintegrated, in the arc, into 2H-atoms. The heat absorbed hereby from the arc is again liberated at the edge of the flame by combination of the 2H-atoms in molecules and pro-



duces a very high temperature of 3000–4000° C. which has the advantage of giving a high welding velocity and a low heating of the piece to be welded. The electrical apparatus used in this process and developed by the G. E. Co. and the A. E. G. are described, especially the burner and the transformer; the figure illustrates the welding capacities obtained under different conditions. Ha(11c)

Resistance Welding in American Automobile Manufacture. (Widerstandsschweissung im amerikanischen Automobilen.) H. DECHAMPS. *Automobiltechnische Zeitschrift*, Vol. 33, Jan. 10, 1931, pages 11–14; Jan. 31, 1931, pages 73–74.

The author points out the much greater use of welding in the manufacture of automobiles and some of the reasons why the German automobile industry is not so far advanced. A great number of special machinery and devices for welding parts are described and illustrated. Ha(11c)

Instruction in Welding. W. H. FLEW. *The Welder*, Vol. 2, Apr. 1931, pages 31–32.

Advocates proper training and careful selection of men. Ha(11c)

Aircraft Welding Requires Proper Tools and Methods. R. F. BISHOP. *Welding*, Vol. 2, May 1931, pages 313–315.

In welding a fuselage, 2 welders begin at the front and proceed toward the rear. The proper method is explained and some precautions to observe are pointed out. Ha(11c)

Six Miles of Automatic Welding. D. G. BAIRD. *Welding*, Vol. 1, July 1930, pages 606–608.

Carbon arc welding is widely used in shipbuilding. Examples of large-bulk cargo vessels and barges are given. The average welding speed was 60 ft./hr. Ha(11c)

Automatic Arc-Welding. F. L. BALLARD. *The Welder*, Vol. 2, Feb. 1931, pages 24–29.

The automatic arc-welder is a device for feeding the electrode from a drum to the work by means of a small constant speed motor driving a pair of knurled feed-rollers; the speed can be varied in the ratio 3:1. The current can be changed from 50 to 300 amp. The whole mechanical arrangement is described and set-ups for a few particular purposes are shown. The machine can be operated by semi-skilled labor. Ha(11c)

Training Arc-Welding Operators in the U. S. A. A. F. DAVIS. *The Welder*, Vol. 2, Apr. 1931, pages 26–30.

Requirements of teachers and students and the proper course of instruction are discussed. Ha(11c)

Manufacture of Welded Pipe by Means of Acetylene Welding. (Die Herstellung geschweisster Rohre mittels der Azetylen-Schweissung.) L. KAYSER. *Forschungsarbeiten auf dem Gebiete der Azetylen-Schweissung, herausgegeben vom Deutschen Azetylenverein*, Jan. 1930, pages 74–101.

In the particular field of welded pipes, research in the quality of the product, as independent of burner and gas quality, showed the same results as given in the paper of Mues in the same magazine. 16 references, many figures and photographs and tables supplement the paper, to which an appendix, treating of such pipes for structure and oxygen and carbon contents, is added. Ha(11c)

Recent Researches in Flame Cutting of Cast Iron. (Neuere Untersuchungen über das Brennschneiden von Gusseisen.) KALISCH. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 5, 1930, pages 61–65.

Cutting of cast iron by the oxygen burner has not given great satisfaction because of the imperfectness of the cutting. Recent tests made with oxygen and a small addition of acetylene gave better results when, at the same time, an additional material in the form of a welding rod was employed; this had the effect of burning the carbon in the iron. Ha(11c)

Modern Applications of Arc Welding. A. M. CANDY (Westinghouse Electric & Manufacturing Company). *Preprint, American Society for Testing Materials*, Mar. 1931, 21 pages.

Deals with necessity for design of structures to be built up by welding in such a manner as to utilize all possible advantages in weight saving rather than merely to duplicate the dimensions and looks of an object formerly made by casting or riveting. Illustrations are given in the field of electrical equipment, buildings and bridges. Advantages of automatic welding machines are stressed and devices for building up worn trolley wheel flanges and axle collars, for longitudinal tube seam welding and automobile rear axle housings, are illustrated. Much greater speed and uniformity of product are possible by automatic than by hand-welding, so when repetition work is concerned, and the cost of special automatic apparatus and of setting-up can be absorbed, it is much cheaper. HWG(11c)

Welding Equipment. (Schweissvorrichtungen.) NARATH. *Die Schmelzschweissung*, Vol. 9, Mar. 1930, pages 52–55.

Description of American and European auxiliary equipment for welding. Ha(11c)

Maintenance Welding in Steel Plants is Essential. E. L. QUINN. *Welding*, Vol. 2, May 1931, pages 320–325.

Welding as maintenance work is advocated; the maintenance department should coöperate with the metallurgical department. Ha(11c)

The Oxy-Acetylene Welding Process in Railway Shops. F. S. TINDER. *Welding*, Vol. 1, July 1930, pages 602–605.

Important points for satisfactory welds are: proper training of welders, supervision, correct preheating and annealing. These points are discussed in detail. Ha(11c)

Applications of the Welding Processes on the Boston & Maine. III. M. A. THOMPSON. *Welding*, Vol. 2, Jan. 1930, pages 168–170.

Cites some cost figures for gas-welding locomotive cylinders, frames and miscellaneous repair jobs. Ha(11c)

Procedure Control for Aircraft Welding. H. L. WHITTEMORE, JOHN J. CROWE & H. H. MOSS. *Welding*, Vol. 1, July 1930, pages 589–590.

The control should extend to apparatus used, such as torches, goggles, gases, hose, test of base metal for physical properties and weldability, welding rod inspection for similarity to material, qualifications. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. Ha(11c)

How Strong Are Welded Joints in Tubular Members of Airplanes? H. L. WHITTEMORE & W. C. BRUEGGEMAN. *Iron Age*, Vol. 126, Dec. 25, 1930, pages 1925–1926.

Taken from a paper read before the National Metal Congress. Gives results of a series of tests. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 914. VSP(11c)

Arc Welding Joints in Steel Structures. R. W. VAN KIRK (General Electric Co.). *American Metal Market*, Vol. 38, Mar. 12, 1931, page 10.

A paper presented at the Welding Conference, Georgia School of Technology, Atlanta, Ga. Electric welding has developed rapidly since 1915. Specifications regarding unit stresses are discussed, also the electric welded buildings of the Dallas Power & Light Co. and Dallas Gas Co. Five advantages of electric welding are: (1) reduction of noise during erection, (2) considerable saving in weight of steel, (3) electrically welded connections can be made stronger than the strongest possible riveted connections for the same purpose, (4) welded connections are more compact and require less material than riveted ones and (5) welded joints will not work loose. Qualifications of welding operators and shop and erection practice are touched upon. WHB(11c)

High Pressure Power Station Piping Welded with Stock Fittings. JOHN H. ZINK. *Welding*, Vol. 1, Apr. 1930, pages 385–389.

Describes the installation in the Bureau of Standards of 2 boilers of 500 and 360 h. p., respectively, at 200 lbs. water pressure and 100° superheating. Cost of welded fittings are compared with screw fittings and saving in weight, cost and labor are described. Ha(11c)

Advances in Welding and Cutting Cast Iron and Cast Steel. (Fortschritte im Schweissen und Schneiden von Gusseisen und Stahlguss.) H. WITTE. *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns*, Vol. 1, Feb. 1931, pages 58–61. 5 references.

General comment. Cutting of cast iron is accomplished by feeding into the cutting torch through a special nozzle, pulverized ferrosilicon, ferromanganese or aluminum, plus a flux such as borax, and maintaining the proper angle between the flame and the piece being cut. HWG(11c)

Lead "Burning" or Welding. FRANCIS A. WESTBROOK. *Metal Industry*, N. Y., Vol. 29, Apr. 1931, pages 152–154; *Metal Industry*, London, Vol. 38, May 8, 1931, pages 477-479.

A description of lead burning practice. PRK(11c)

Manufacture of Steel Elbows with Cutting and Welding Torch. (Stahlrohrkrümmerherstellung mit Schneid- und Schweissbrenner.) WECKWERTH & AMLING. *Die Schmelzschweissung*, Vol. 10, Apr. 1931, page 91.

A method is described and a table given for producing curved joints by cutting out triangular pieces from a cylindrical pipe, bending and welding the faces together, for use under any condition where standard fittings cannot be used. Ha(11c)

Small Crane Type Plate Shop All Welded. C. G. WATSON. *Welding*, Vol. 1, Apr. 1930, pages 390–391.

Describes the erection of a building with welded roof construction. Ha(11c)

Design and Uses of Arc-Welded Joints. NAT. WARSHAW. *Welding*, Vol. 1, July 1930, pages 591–595.

Thirty different joints are illustrated and their use recommended in the construction of machinery which can be made more economically in this way. Ha(11c)

Comparative Tests of Rivet and Plug Welds. THOS. K. VINCENT. *Welding*, Vol. 2, May 1931, pages 316–319.

Tests undertaken to determine whether it is economical to punch holes in one of 2 plates and then fasten the plates by plugging the holes with weld metal, fusing the plugs into the unpunched plate. No marked improvement could be noted from the tests and so the question remains open. Ha(11c)

Welded Pressure Vessels in England. *Welding*, Vol. 1, Apr. 1930, pages 378–383.

A tabulation of different methods of joining plates with coefficient of strength in percent of the solid metal is given and the factors necessary to secure a good weld are discussed. Ha(11c)

Successful Welds with Galvanized Iron. *Welding*, Vol. 1, Apr. 1930, pages 375–376.

Where the galvanized coating is destroyed by welding, welds are made either with a steel welding rod and later given a coat of paint, or with a bronze welding rod which needs no coating. The latter method has lately found fairly wide application for water lines of galvanized pipes. Ha(11c)

Railroad Welding Practice in Europe. *Welding*, Vol. 1, Apr. 1930, pages 371–374.

Shows illustrations of car underframes welded in Belgium. Ha(11c)

Welded Reinforcement for Water Pipe. *Welding*, Vol. 1, Jan. 1930, pages 181–184.

The method of laying of 2627 sections of 27 in. pipe 12 ft. long is described in detail. Ha(11c)

The Atomic Hydrogen Welding Process. *The Welder*, Vol. 2, Feb. 1931, pages 30–36.

The principle of this process consists of feeding hydrogen gas to 2 tungsten electrodes set at an angle of about 30°; a set of nozzles sends a stream of hydrogen to the points of the electrodes, thus performing the welding process in an atmosphere of hydrogen. Diagrams of electrical connections, mechanical arrangements and microphotographs are given. An average of 40 ft.³/hr. of gas is used. Ha(11c)

The Fabrication and Welding of H. R. Crown T Steel in Czecho-Slovakia. *The Welder*, Vol. 2, Feb. 1931, pages 16–19.

Brief description with photographs of 4 tanks 1000 mm. in diameter, 1200 mm. deep and 3.5 mm. thick of 18/8/1 chromium-nickel-tungsten steel. Ha(11c)

Pipe Welding, How, When and Where to Do It. WM. SPRARAGEN *Welding*, Vol. 2, May 1931, pages 303–307; June 1931, pages 389–393.
A general discussion of joining pipes for long pipe lines; butt joints, bell joints, sleeve reinforced joints are described. Ha(11c)

Welding High Manganese Steels, a Discussion of the Physical Properties, Weld Preparation and Procedure. *Welding News*, Vol. 2, Jan. 1931, pages 1–3.
Costly replacements of high manganese steel pieces can often be delayed by building up the worn parts, but the process must retain the high resistance against abrasion in the built-up part. It is recommended that the deposits be laid on in a series of pads instead of beads; the pads should be about 1 in. wide and $1^1/_4$ in. long. Before it cools to a dull red, the pad should be peened and hammered until almost cold. After cooling with water, the remaining strains should be taken out by hammering again. Instructions for the preparation of the work are also given. Ha(11c)

Directions for the Welding of Steel Structures. (Richtlinien für die Ausführung von Stahlbauten.) *Die Schmelzschweissung*, Vol. 9, Mar. 1930, pages 50–51.
This is a draft for general rules to be observed in welding structures, intended as an appendix to German official regulations and dealing with calculation and numerical values of stresses, guaranty tests of welds, erection instructions. Ha(11c)

Tests on Spot Welder. R. J. WILSON & P. L. ORR. *Welding*, Vol. 2 Apr. 1931, pages 238–241; May 1931, pages 300–302.
The article deals with the best ratio between spot diameter and plate thickness when using an electrode pressure of 14,000 lbs./in.^{2} throughout. A work sheet for different conditions is given. The tests were conducted with regard to pressure/unit square of electrode area to be applied, heat required for different thickness as well as the above-mentioned ratio. The results are given in tables and curves. Ha(11c)

The Training of Welders. D. RICHARDSON. *The Welder*, Vol. 2, Apr. 1931, pages 23–25.
A survey of different training methods in America and the Continent. Ha(11c)

The Welding of a Turbine Cylinder. P. L. ROBERTS. *The Welder*, Vol. 2, Feb. 1931, pages 11–15.
The iron casting for a turbine cylinder was found, after considerable machining had been done, to be defective; a great blow-hole and sand spot was found in the head. The correction of this defect by arc-welding is described in detail. After 2 years, the turbine is still running satisfactorily. Ha(11c)

Welded Steel Structures. Part II. EDWARD DACRE LACY. *Metallurgia*, Vol. 3, Feb. 1931, pages 151–152.
Welding construction is increasing in spite of many handicaps. JLG(11c)

Atomic Hydrogen Arc-Welding Process. *Electrical World*, Vol. 97, May 2, 1931, page 836.
A complete atomic-hydrogen arc-welding process has been developed in England. An alternating current is maintained between adjustable tungsten wire electrodes and hydrogen gas is fed to the arc around the electrodes. Hydrogen molecules are broken into atoms and, in recombining outside of the arc, heat is liberated far in excess of that obtained by a gas flame alone. This heat is used to fuse the metals to be joined. A transformer furnishes the required voltage and the current at the arc is regulated by a controlling reactor. High voltage and low currents are required in the arc. The arc is struck at 300 volts, but while welding the arc voltage is varied from 90 for light work to 60 for heavier, and the current correspondingly varies from 15–70 amps. WHB(11c)

Elementary Training in Welding. J. N. LONG. *The Welder*, Vol. 2, Apr. 1931, pages 19–22.
Outline of the course of the (British) Institution of Welding Engineers. Ha(11c)

Gas Engine Pistons Repaired by Welding. ORVILLE ADAMS. *The Welder*, Vol. 2, Apr. 1931, pages 13–15.
Description and illustrations of 29.5-in. pistons of 2000 h.p. tandem engine. Ha(11c)

Automatic Arc Welding. G. H. KOCH. *Electrical Engineering*, Vol. 50, May 1931, pages 358–360.
The use of arc welding has effected marked savings in the manufacture of electric apparatus. Automatic control has promoted still greater savings and better and more uniform products. Some savings in welding time are illustrated. WHB(11c)

The Strength and Design of Fusion Welds for Unfired Pressure Vessels. L. W. SCHUSTER. *Proceedings Institution of Mechanical Engineers*, No. 2, Mar. 1930, pages 319–417.
Includes discussion and appendix which presents tentative rules for fusion welding of unfired pressure vessels. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. RHP(11c)

An Advanced School for Welding Technique in France. (Eine höhere Fachschule für Schweisstechnik in Frankreich.) *Die Schmelzschweissung*, Vol. 10, Feb. 1931, page 29.
Practical and theoretical education for welders in 8 months. The whole course is outlined. Ha(11c)

The Use of a Cleansing Flux on the Reverse Side of the Weld. *Welding News*, Vol. 2, Jan. 1931, page 6.
Fluxes are used to eliminate and clean the oxides formed during the welding process. They are usually applied in the form of the filling rod. It was found that the application of the flux on both sides of the weld is of great advantage, especially with some metals that are more difficult to weld, such as aluminum. A few hints are given on the successful performance of this method. Ha(11c)

Autogenous Welding in French Boiler Construction. (Die autogene Schweissung im französischen Dampfkesselbau.) *L' Usine*, Vol. 39, April 25, 1930, page 47; *Die Schmelzschweissung*, Vol. 10, Feb. 1931, page 35.
The French ministry for public works has published regulations for autogenous welding for the construction and repair of boilers which give explicit instructions on how and when and with what precautions this method is permitted. Burner and consumption of acetylene and dimensions of electrodes are to be of approved construction. Ha(11c)

New Cross-field Welding Generator QV121. (Neuer Querfeld-Schweissgenerator QV121.) *AEG-Mitteilungen*, Vol. 4, Feb. 1931, page 81–83.
Description of the new DC-welding generator of the AEG for constant current, maximum 250 amp. which can be adjusted to any current desired by field regulators. Over-all efficiency of the welding plant 55 to 60%. Ha(11c)

Weapons of War Fabricated by Welding. J. B. ROSE. *Welding*, Vol. 2, Apr. 1931, pages 258–261.
The same factors that are causing many manufacturers of metal parts to turn to welding as a fabricating tool are responsible for the Ordnance Department of the U. S. A. to adopt welding as a process for assembling large and small guns. These factors eliminate castings to save weight and spoilage, to obtain a more rigid and dependable product, to improve on design, to reduce costs and speed up production . Some examples are illustrated. Ha(11c)

A Study of Gas Welds Made with Various Rods. *Welding*, Vol. 2, Jan. 1931, pages 34–36.
Describes a series of tests with oxy-acetylene welding to determine physical and microscopic properties of steel, cast iron and brass welds with several welding rods. All joints were simple, horizontally welded butt joints. Tables and micrographs illustrate the results which emphasize the importance of a skilled welder. Ha(11c)

Repairing Gears by Gas Welding. *Welding*, Vol. 2, Jan. 1931, page 24.
A few points on how best to proceed. Ha(11c)

Welding in Manganese Steel Plant. JOS. A. COYLE. *Welding*, Vol. 2, Feb. 1931, pages 97–98.
Oxy-acetylene cutting and electric welding is used by the American Manganese Steel Co. in Denver for their products of manganese steels used in railroad switches, airplanes, etc. The cost of production is reduced thereby. Ha(11c)

A 40,000-Lb. Steam Hammer Repaired by Welding. W. TH. P. MAEDER. *Welding*, Vol. 2, Jan. 1931, pages 20–21.
The piston rod of this hammer snapped and the base was broken. It was repaired by arc-welding in 10 days instead of the 30 days required if the pieces had been sent to the manufacturer. Ha(11c)

Use More Welded Structural Steel in United States. FRANK P. MCKIBBEN (General Electric Co.). *Steel*, Vol. 87, Aug. 7, 1930, pages 48, 50.
From paper presented at World Power Conference, Berlin, June 1930. Complete article appeared in *General Electric Review*, Vol. 33, Aug. 1930, 453-455. MS(11c)

Welding of Structural Steel Requires Understanding. FRANK P. MCKIBBEN. *Steel*, Vol. 87, Sept. 18, 1930, pages 60, 62.
Consists of 35 questions with brief answers. MS(11c)

All-Welded Automobile Shelter. J. F. MINNOTTE. *Welding*, Vol. 2, Jan. 1931, pages 37–39.
Replaces a wooden building; details of construction. Ha(11c)

Welded Radiators for Warm Water Heating. (Geschweisste Heizkörper für Warmwasserheizung.) M. MENGERINGHAUSEN. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 71–74.
Ornamental designs in various metals with regard to good radiation, easy accessibility for inspection and repair and possibility of extensions. Ha(11c)

Welding Cast Iron with Metallic Arc. M. C. MCOSCAR. *Welding*, Vol. 2, Jan. 1931, pages 31–33.
For successful welding of cast iron, the following 5 points are impressed: (1) The long arc produces a shallow crater preventing absorption of excessive carbon. The alternately long and short arc should be extensively practiced. (2) Sodium hydroxide with some binder, as slaked lime, should be used for welding iron not fusing readily. (3) Phosphor-copper or cupro-nickel alloy produces a machinable weld in cast iron, but should be used only on surfaces to be machined; all other welding should be done with a soft iron filler metal. (4) Peening where possible relieves contraction strains. (5) The weld or casting should never be permitted to become overheated while welding. This is extremely important. Ha(11c)

Rules for Welded Construction of Heating Installations. (Schweisstechnische Konstruktionsregeln bei der Herstellung von Heizungsanlagen.) W. JOHAG. *Schmelzschweissung*, Vol. 10, Mar. 1931, pages 53–54.
Welded constructions adapt themselves readily to local conditions; a few hints are given for the selection of parts and shapes to fit into a certain condition. Ha(11c)

Welded Joints in the Construction of Air Heaters. (Die Anwendung der Schweissverbindung beim Bau von Lufterhitzern.) R. BRASS. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 75–76.
Some constructions of pipe lines, ducts and heaters. Ha(11c)

Mechanical Difficulties Overcome in Welding Spiral Pipe. LEON CAMMEN. *Machine Design*, Vol. 3, May 1931, pages 43–45.
Describes several arrangements for rotating a cylindrical body by friction and at the same time moving the body forward, with special reference to the kind used in welding spiral pipe. A rope drive is a most effective type. Ha(11c)

Influence of Coatings of Welding Rods on the Strength of the Weld. (Einfluss von Umwicklungen der Schweisstäbe auf die Festigkeit der Schweisse.) K. BAUMGAERTEL. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Jan. 10, 1931, pages 53–54.
See *Metals & Alloys*, Vol. 2, Mar. 1931, page 70. Ha(11c)

What Has Been and Will Be Accomplished in the Field of Structural Arc-Welding. A. F. DAVIS. *Welding*, Vol. 2, Apr. 1931, pages 246–251.
The author reviews the methods applied in welding large structures, such as buildings, and investigates how much of it should be done in the shop and how much left to field-welding. He illustrates his point with a few examples. He recommends a certain standardization of parts and methods, and discusses inspection and tests to guarantee safety. A big asset of the welding method is the elimination of noise and possible economies in weight and speed of erection. Ha(11c)

Producing Electric Welded Pipe. A. H. ALLEN. *Steel*, Vol. 87, Aug. 14, 1930, pages 43–46.
Describes plant and practice of the Republic Steel Corp., Youngstown, Ohio. One unit forms and butt-welds 8-in. pipe in 40-ft. lengths at a speed of 40–60 ft./min. The process used is an amplification of the Johnson process for electric welding. It is a resistance welding process in which alternating current at high amperage is employed, no external weld metal being necessary. Each length is subjected to hydrostatic and hammering tests. It is claimed that the weld is stronger than the adjacent metal and has a sound microscopic structure. MS(11c)

Electric Railway Builds Welded Frogs. C. ANDERSON. *Welding*, Vol. 2, Feb. 1931, pages 93–94.
The Havana Electric Railway has constructed arc-welded frogs of steel rails and steel plates, cut to size and shape so as to fit into one another. It is claimed they are stronger, require less attention and maintenance work and are less likely to break. Ha(11c)

Design and Construction of Wrought Iron Water Tanks for Heating Purposes. (Bauart und Herstellung schmiedeeiserner Wasserbehälter für Heizzwecke.) ALFRED NAUCK. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 67–70.
Construction data for boilers with dimension tables for different capacities, for registers, heating spirals, etc., by welding. Ha(11c)

Welding Practice at San Francisco Plant of Link-Belt Company. G. P. NEWTON. *Welding*, Vol. 2, Mar. 1931, pages 188–190.
Welding has simplified design and layout work and produced conveyor equipment stronger than riveted construction. Ha(11c)

Fatigue Properties of Welds. J. B. JOHNSON. *Welding*, Vol. 2, Mar. 1931, pages 159–163.
Describes some fatigue test with results, from which it is concluded that the removal of the bead has little effect on a butt-welded seam on large parts but a considerable effect on small pieces about $^3/_4$ in. in diameter. Heat treatment such as annealing or normalizing will raise the fatigue limit. Improvement in welding technique which reduces the number and size of the oxide particles and blow-holes will also raise the fatigue limit. Six bibliographic references. Ha(11c)

Welding of Copper-Nickel Alloys. (Die Schweissung von Kupfer-Nickel-Legierungen.) HANS A. HORN. *Autogene Metallbearbeitung*, Vol. 24, Apr. 15, 1931, pages 119–122.

Exhaustive tests made with water-cooled pipes of Cu-Ni alloy were made to determine their behavior in sea water, when used as exhaust pipes in Diesel engines in ships. The alloys tested were 70% Cu with 30% Ni and 80% Cu with 20% Ni. It was found that these alloys can be welded even better than copper as the alloy is very liquid and clean welding seams can be made. Acetylene is well suited for welding these, but not hydrogen and illuminating gas. The acetylene must be absolutely free of hydrogen sulphide since, otherwise, brittle sulphur-nickel is formed. When welding sheets, it must be done very quickly and without interruption. Re-welding of welded seams is to be avoided. The welding rod must be of the same composition as the alloy and the thickness of the wire should be about the same as that of the piece to be welded. Ha(11c)

Items Affecting Welding Costs. W. L. FRANKLIN. *Welding*, Vol. 2, Apr. 1931, pages 232–234.

A brief analysis of those items which constitute welding costs. The influence of properly laying out the welding shop and the work to be done is discussed and a chart suggested for showing the cost relations. Ha(11c)

Gas Welding in Ventilation and Dust Exhaustion Installations. (Die Gasschmelzschweissung bei Entlüftungs- und Entstaubungsanlagen.) KARL FUNK. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 78–79.

Description of entirely welded ducts, joints and collecting tanks. Ha(11c)

Welding of Copper in Building of Apparatus. (Das Schweissen von Kupfer im Apparatebau.) GEIGER. *Die Schmelzschweissung*, Vol. 10, Feb. 1931, pages 37–38.

Riveting of copper vessels which are subject to temperature changes is unsatisfactory as the rivets soon become loose. Welding must be done by oxy-acetylene as experience has shown that electrically welded joints are not sufficiently corrosion-proof nor possess sufficient toughness and density. Due to the high thermal conductivity of copper, larger burners must be used than for iron. After welding, the seam must be strongly hammered and heated to about 500° to 550° C., then quickly cooled by compressed air or water. Instructions for making satisfactory welds are added and a few examples are described. Ha(11c)

Autogenously Welded Pipe Structures and their Flow-Resistance. (Autogengeschweisste Rohrformstücke und ihr Stromungswiderstand.) W. GELDBACH. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 64–66.

By properly shaped joints, knees, etc., the losses due to flow-resistance can be appreciably reduced. A table gives the loss coefficients for different elbows and flow velocities. Instructions for making branches are added. Ha(11c)

New Application Possibilities of Autogenous Welding in Ornamental Iron Work. (Neue Anwendungsmöglichkeiten der autogenen Schweissung bei Eisenarbeiten.) J. BLUEMMEL. *Die Schmelzschweissung*, Vol. 10, Feb. 1931, pages 27–28.

In a few examples, it is shown how the crater forming in welding might lend itself as a characteristic element in producing artistic effects in welded ornamental iron work. Ha(11c)

Welded Structures in Germany and Austria. OTTO BONDY. *Welding*, Vol. 2, Feb. 1931, pages 110–113.

The new rules governing the erection of welded steel buildings as issued by the Prussian Ministry of Public Safety are cited and a few remarkable structures are discussed and illustrated. Ha(11c)

Repair to Stone Crusher Jaw. JAMES LYALL. *Welding*, Vol. 2, Mar. 1931, page 174.

A broken piece of cast iron 7 × 3½ in. and 8 in. long had to be replaced. Repair was done in 10½ hr. in a fairly out-of-the-way place. Ha(11c)

Welding Plates and Pressure Vessels. P. R. HAWTHORNE. *Welding*, Vol. 2, Feb. 1931, pages 89–92.

The author shows in several examples that by the use of proper welding methods, procedure control and method of annealing, welded vessels for high pressures are made stronger than riveted vessels. Such vessels should, however, always be annealed after welding; a car type annealing furnace is described. Ha(11c)

Tests on Arc-Welded Parts of Iron Structures. (Versuche an lichtbogengeschweissten Eisenkonstruktionen.) K. LIEDLOFF. *Die Schmelzschweissung*, Vol. 10, Apr. 1931, pages 99–100.

Communicated by the Lehr- und Versuchswerkstätten für Schweisstechnik, Charlottenburg. Description of 12 tests with welded structural iron parts as they were made by the Westinghouse Elec. & Mfg. Co. to obtain preliminary information for the welding of a 5-story building. Ha(11c)

Thermit-Welding Practice in England. E. DACRE LACY. *Welding*, Vol. 2, Mar. 1931, pages 177–179.

Special reference is made to the application of this method for rail joints. A series of tests is described. Ha(11c)

All-Welded Railway Fuel Tank. JAMES LYALL. *Welding*, Vol. 2, Mar. 1931, page 187.

A gas tank made of ½ in. plate, 6 ft. in diameter, 23 ft. 6 in. long. Longitudinal seams are butt-welded, circumferential seams are lap-welded. Ha(11c)

Oxy-Acetylene Welding Local Gas Lines. L. A. KIRCH. *Welding*, Vol. 2, Feb. 1931, pages 99–100.

Describes method of welding and testing 2 in. mains; it pays because of reduced maintenance cost and gas leakage. Ha(11c)

Develops New Technique in Electric Arc Welding. J. D. KNOX. *Steel*, Vol. 87, Oct. 9, 1930, pages 62, 65.

Describes work carried out at Barberton, Ohio, plant of Babcock & Wilcox Co. New type of electrode has been developed and a special arc-welding machine evolved. Weld metal contains 0.30–0.60% Mn, 0.08–0.15% C, and less than 0.04% S, 0.04% P and 0.02% N. Electrode produces a quiet and stable arc and causes practically no spattering of metal. Rod is mounted vertically in a feeding device which is self-propelled forward or backward by an adjustable speed motor. Steel drums must be annealed after welding operation. Weld metal had ultimate tensile strength of 65,000–74,500 lb./in.², yield-point of 40,000–55,000 lb./in.², elongation in 2 in. of 20.5–38%, reduction in area of 32–65%, and Charpy impact values of 20–45 ft.-lb. Rotating-beam tests indicated an endurance limit of about 30,000 lb./in.² Finished products are subjected to repeated pressure tests, X-ray examination and electromagnetic tests. MS(11c)

Influence of Pressure Conditions in the Oxy-Acetylene Burner on the Economy and Quality of the Weld. (Einfluss der Druckverhältnisse im Azetylen-Sauerstoff-Schweissbrenner auf die Wirtschaftlichkeit und Güte der Schweissung.) H. KEMPER. *Forschungsarbeiten auf dem Gebiete der Azetylen-Schweissung*, Jan. 1930, pages 53–83.

The tests were made with the following types of burners: (1) Injector burners with (a) low pressure gas, (b) high pressure gas. (2) Burners with mixing-nozzles or uni-pressure burners. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 851. Ha(11c)

Automatic Gas-Cutting of Irregular Shapes. THOS. D. KETCHBAW. *Welding*, Vol. 2, May 1931, pages 297–299.

The methods for laying out templets, cutting with flame, adjustment of gas pressures, etc., automatic cutting and speed of cutting used by the Santa Fe Railway are described. The speed of cutting can be considerably increased by pre-heating the material to about 1000° F. Ha(11c)

WORKING OF METALS & ALLOYS (12)

The Manufacture of Steel Sheets. E. S. LAWRENCE. Penton Publishing Co., Cleveland, 1930. Cloth, 6 × 9¼, inches, 233 pages. Price $6.15.

This book is written to give the interested layman, such as the purchaser of automobile sheets, some insight into the processes by which sheet is made. It is somewhat doubtful whether one with absolutely no metallurgical background could follow all the chapters without considerable mental effort. The experienced sheet mill metallurgist will probably consider the treatment rather elementary. Other metallurgists will find the book interesting and readable.

Lawrence characterizes box annealing as an unsound method of heat-treatment which will ultimately be displaced. He visualizes continuous strip rolling, followed by pack rolling on a sheet mill, then by continuous normalizing by a cycle that will be the equivalent of normalizing plus box annealing, and finally by pickling and cold rolling for surface, as the probable future method.—H. W. Gillett (12)-B-

Melting & Refining (12a)

Manufacture and Casting of Acid and Basic Open-Hearth Steel. DANIEL CLARK. *Transaction & Bulletin, American Foundrymen's Association*, Vol. 1, Feb. 1930, pages 22–35; Mar. 1930, pages 26–44; Apr. 1930, pages 18–29.

The paper was segregated into the following headings: historical; observations in the manufacture of producer gas; acid open-hearth steel in the furnace; basic open-hearth steel in the furnace; the casting of acid and basic open-hearth steel into (a) ingots, (b) foundry work; non-metallic inclusions, their occurrence and effect; and the relative merits of acid and basic open-hearth steel. CHL(12a)

Fundamental Facts on the Physical-Chemistry of Steel Making Processes. (Grundsätzliches über die physikalisch-chemische Untersuchung der Stahlerzeugungsverfahren.) F. SAUERWALD. *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 361–366.

Report 201 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The article gives a theoretical deduction of the methods which must be applied in studying the physico-chemistry of the steel making process, outlines the suppositions which must be fulfilled in studying equilibria and makes suggestions for further research. GN(12a)

Melts Iron and Steel in Electric Furnace. GILBERT S. SCHALLER. *Foundry*, Vol. 58, Aug. 15, 1930, pages 48–51.

Gray Fe superheated in electric furnace will produce castings having close grained structure with resistance to wear. Discusses results obtained by Lidgerwood Pacific Co., Tacoma, Wash., and describes equipment used. VSP(12a)

Production of High Grade Iron from Scrap in the Electric Furnace. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1353–1358.

York Ice Machinery Corp., York, Pa. produces high-strength irons in a 1-ton, rocking-type, indirect-arc furnace from a charge consisting entirely of scrap material, without the addition of any alloys. Metal is poured at 2800° F. Time from charging the furnace to pouring the metal ranges from 80–85 min. Electrode consumption is 5½ lbs. C per ton of iron melted. Power consumption averages about 560 kwh. per ton of metal melted. MS(12a)

High-Frequency Furnace Produces Pure Steel. RUDOLF HOHAGE & BERNARD MATUSCHKA. *Steel*, Vol. 87, Dec. 11, 1930, pages 55–56.

Translated from the *Schoeller-Bleckmann News*. Schoeller-Bleckmann A.-G. was one of the first European steel plants to install a high-frequency furnace. Such high efficiencies are attained that the process can compete with other steel manufacturing methods. A charge of about 660 lbs. is melted in slightly over an hour. Melting takes place in the absence of all detrimental gases. Due to the deoxidizing action of the Si from the melting crucible and to the uninterrupted, slow, automatic mixing resulting from the circulation created by the magnetic fields set up in the bath, the steel produced is unusually free from inclusions and is homogeneous throughout. Cleanliness of high-frequency crucible steel exceeds that of ordinary crucible steel. Points out the importance of this factor by briefly discussing the deleterious effects of inclusions. MS(12a)

The Reactions of Iron Sulphide, Manganese Sulphide and Calcium Sulphide with Iron Oxides. (Ueber die Umsetzungen von Eisensulfid, Mangansulfid und Kalziumsulfid mit den Oxyden des Eisens und dabei auftretende Nebenreaktionen.) E. DIEPSCHLAG & E. HORN. *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 375–382.

An analytical method was developed to determine Fe″ and Fe‴ in the presence of sulphides. The reaction $FeS + 10\ Fe_2O_3 = 7\ Fe_3O_4 + SO_2$ starts at 550° C. and is completed at 850° C. The occurrence of free ferrous oxide at temperatures up to 900° C. could not be substantiated, as it has been found by L. Wöhler and his collaborators. Excessive FeS starts to react with Fe_3O_4 at temperatures of around 1100° C., according to the equation $FeS + 3\ Fe_3O_4 = 10\ FeO + SO_2$. A total decomposition of iron oxides to ferrous oxides in the presence of excessive sulphide is achieved when the mixtures are heated to 1300–1350° C. The reaction $MnS + 9\ Fe_2O_3 = MnO + 6\ Fe_3O_4 + SO_2$ starts at 550° C. and is completed at 850° C. MnS and Fe_3O_4 reacted at 975° C. The reactions with CaS differ from the above reactions, inasmuch as the calcium ferrites formed are reduced to CaO and FeO by excessive CaS. With calcium ferrites for reduction substances, it was found that the ferrites react with CaS and FeS at temperatures of 800° C. After the reaction has taken place to a certain extent, the reaction velocity with CaS decreases, but rapidly increases again between 1150° and 1200° C. The formation of the compound $3\ CaO \cdot Fe_2O_3$ is assumed. This assumption is verified by the fact that mixtures of $3\ CaO + Fe_2O_3$ react at 1150° C. in a similar way as the above mixtures. None of the above reactions could be reversed. An explanation is given as to how the sulphur segregated during the experiments is formed. GN(12a)

Melting German Silver Alloys. JOSEPH P. MCGINNIS. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, page 556.

Gives formulas used by the author for German silver alloy castings. VSP(12a)

Quality Control, Alloy Contamination in Making Open-Hearth Steel. *Iron Age*, Vol. 126, Dec. 4, 1930, pages 1701, 1745–1746.

Taken from Cleveland meeting of the open-hearth operators, under the auspices of the American Institute of Mining and Metallurgical Engineers. Discusses some of the metallurgical and other features of open-hearth steel plants. VSP(12a)

The Scientific Production of Non-ferrous Ingots. WALTER H. JACOBSON & WILLIAM KELLY (Tottenville Copper Company, Inc.). *Metal Industry*, N. Y., Vol. 29, Apr. 1931, pages 149–151.

The various advantages of using brass and bronze ingots made from secondary metals under close chemical control and microscopic and macroscopic examination are mentioned. A table of the chemical specifications for 15 alloys recommended for non-ferrous ingots is given. PRK(12a)

Copper Refining. (Die Kupferraffination.) M. WAEHLERT. Wilhelm Knapp Verlag, Halle, 1927. Paper, $6^1/_2 \times 9^1/_2$ inches, 142 pages. Price 11.40 RM.

The author of this book on copper refining has been superintendent of the copper refinery of the Osnabrück Copper and Wire Plant, Osnabrück, Germany, for many years. He deals with his subject with authority, gained by a scientifically trained mind and a clear sense of finding facts.

The book covers the material designated by the following 8 chapters: raw materials, refining furnaces, charging of furnaces, process of refining, methods of casting, melting of slags in the cupola, lay-outs of plants, production costs. Among the subjects covered, the physical chemistry of the refining process takes the largest space (nearly 40 pages) which goes to show that the author endeavored to go back to the root of many troubles which copper offers in the processing to the finished product, such as fine wire. Certainly, the correlations between copper, oxygen, poling gases and impurities have a good deal to do with the quality, the process of crystallization and the surface conditions of the cast refined copper, which factors in turn affect the behavior in final processing to the finished product to a large extent. The author gives his own observations and evaluates them. This certainly is the most valuable accomplishment of the book which makes it worthwhile reading for every copper metallurgist.

In the appendix, a review of the literature on the subject is included.—G. Neuendorff (12a)-B-

Electric Furnaces for Steel Melting. N. R. DAVIS & C. R. BURCH. *Transactions, Manchester Association of Engineers*, 1929–30, pages 146–162.

Includes discussion. Deals chiefly with high frequency induction melting. A sketch of a 500 lb. steel furnace is shown. No difficulty is met from the active circulation in the furnace. Even without a quiescent period at the end of the melt, the furnace produces clean metal. A 10-ton furnace can now be designed with confidence. See also *Metals & Alloys*, Vol. 1, Mar. 1930, page 429. HWG(12a)

Manufacture of Duplex Steel. J. E. CARLIN. *Transactions American Society for Steel Treating*, Vol. 17, May 1930, pages 631–637; *Iron Age*, Vol. 125, Mar. 27, 1930, pages 925–927; *Iron & Coal Trades Review*, Vol. 120, June 6, 1930, pages 913–914.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. RHP(12a)

Operation and Metallurgy of a 200-Ton Tilting Furnace for the Talbot Method. (Betrieb und Metallurgie eines 200-t.-Kippofens für das Talbot-Verfahren.) W. ALBERTS. *Stahl und Eisen*, Vol. 51, Jan. 29, 1931, pages 117–128.

Report 200 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The investigation covers metallurgy and economics of a modern tilting furnace of 200 tons capacity. In particular, the occurrences during the deoxidation period with either solid or liquid ferromanganese have been studied. It could be proven that the deoxidation with molten ferromanganese is superior to the deoxidation with solid ferromanganese, as far as the effect is concerned. Mechanical tests on steels made according to the Talbot method show that this steel is not inferior to open-hearth steel made in other furnaces. Due to the fact that there is available a sufficient number of smaller open-hearth furnaces for making special steels, it seems advisable to build tilting furnaces for the Talbot method in the case of reconstruction of furnaces. GN(12a)

Investigations into the Chemical Processes of the Acid Steel Production Methods and of the Deoxidation of Steel by Manganese and Silicon. (Untersuchungen über die chemischen Vorgänge bei den sauren Stahlerzeugungsverfahren und bei der Deoxydation des Stahls mit Mangan und Silizium.) HERMANN SCHENCK. *Krupp'sche Monatshefte*, Vol. 12, Apr. 1931, pages 63–81.

The very close metallurgical similarity of the reactions of Mn and Si in the acid steel production processes and in deoxidation can be utilized to draw conclusions from one to the other. The theory of processes is developed in detail. For the determination of the equilibrium in the complex system, the knowledge of the equilibrium constants for the reactions $FeO + Mn \rightleftarrows MnO + Fe$ and $2FeO + Si \rightleftarrows SiO_2 + 2Fe$ and of the dissociation constants of the manganese- and iron-silicates are necessary. If 2 of the required quantities are known, the others can be calculated from tests on the open-hearth furnace or on the Bessemer converter. After a tabulation of numerical values at present available, determination of the constants of the afore-mentioned reactions by affinity calculation was attempted. The comparison of calculated constants with previous test results permits the conclusion that the calculated figures are sufficiently useful for judging the deoxidation with Mn or Si alone. All results are represented in the diagrams and calculated values tabulated. 55 bibliographical references. Ha(12a)

Casting & Solidification (12b)

The Structure of Cast Alloys. (Die Struktur von Gusslegierungen.) MARIE L. V. GAYLER. *Metallwirtschaft*, Vol. 10, Feb. 20, 1931, pages 141–144.

Contains 3 references. An aluminum alloy containing 7% copper was melted in a high frequency induction furnace and held in a vacuum, in presence of air, nitrogen, hydrogen and furnace gases for 25 minutes. One set was cast at 740° C. and another at 840°. Each heat was cast into 4 different molds: steel, graphite, water cooled copper and sand. Macrophotographs of the structures are shown. The furnace atmosphere has little effect on the specimens cast at 740°. The macrostructure in all is fine grained, in those melted in vacuum and under hydrogen the finest. Those cast in sand are somewhat coarser than those cast in steel. The microstructure is the same in all. The macrostructure of the set cast at 840° into steel molds is coarser than that cast at 740° and there is much more difference between different furnace atmospheres. Furnace gases produce the coarsest grain and the difference is still greater when cast in sand. The microstructure is finer grained at the higher casting temperature. Both series cast in water-cooled molds have a similar fine grained macrostructure, with little difference between the various furnace atmospheres. CEM(12b)

Aluminum Kitchenware Is Cast in Permanent Molds. J. B. NEALEY. *Foundry*, Vol. 58, Oct. 1, 1930, pages 86–87, 89.

Present-day production of Al or Al alloy castings is divided into three methods—sand casting, permanent mold and die casting. Permanent mold alloys of Cu, brass, etc., melting in neighborhood of 2000° F. are used. Describes method used by the Monarch Aluminum Ware Co., Detroit. Castings with almost any combination of physical properties are used, mostly Al. Most common alloy used contains 92% Al and 8% Cu. When poured this alloy develops tensile strength of 18,000 to 20,000 lbs./in.², yield point of about 16,000 lbs./in.² and an elongation of 2 to 5%. Another alloy contains 95% Al and 5% Si, having tensile strength of about 24,000 lbs./in.², yield point of 17,000 to 18,000 lbs./in.² and elongation of 4 to 5%. Still another consists of an Al base with Ni, Mg and Mn, developing a tensile strength of 35,000 to 40,000 lbs./in.². Several types of melting furnaces are used. Retort is split longitudinally. Gas fired furnaces used for annealing and heat treating. After material has been brought to temperature for heat treating it must be soaked for a certain period before quenching. VSP(12b)

Trend in Steel Ladle Design Toward Two-Stopper Units. Attributes Cracked Corners on Ingots to Preparation of Molds. *Steel*, Vol. 87, Nov. 27, 1930, pages 48–49.

Report of the 12th semi-annual meeting of the Open-Hearth Committee of the American Institute of Mining and Metallurgical Engineers, Cleveland, Nov. 20–21, 1931. Includes abstracts of discussion on questions other than those indicated by the titles. MS(12b)

Heterogeneity of an Ingot Made by the Harmet Process. A. KRIZ *Rolling Mill Journal*, Vol. 4, Nov. 1930, pages 621–622.

From paper read before the Iron and Steel Institute. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 915. MS(12b)

Rolling (12c)

The Economical Application of Compressed Scrap in Open Hearth Practice. (Die Wirtschaftlichkeit der Verwendung von Paketschrott im Siemens-Martin-Betrieb.) J. PANZL & TH. DAHMEN. *Stahl und Eisen*, Vol. 51, Jan. 8, 1931, pages 47–49.

The authors give the results of preliminary tests on compressing low grade scrap in order to determine whether or not there is a possibility of rolling these scrap bars directly to muck bars. Though no structural uniformity can be obtained, it is noticeable that a tensile strength between 32.3 and 34.4 kg./mm.² with 12.7% to 25% elongation has been obtained with bars of the average composition: C: 0.035–0.06, Si: 0.01–0.10, Mn: 0.36–0.45, P: 0.019–0.044, S: 0.05–0.07. GN(12c)

Aluminium Sheet Production, Part V—Rolling Ingots. ROBERT J. ANDERSON. *Metallurgia*, Vol. 3, Feb. 1931, pages 137–140.

Bibliography of 26 references. Describes various shapes of ingots. The sizes vary from 20 to 20,000 lbs., but the majority of the sheet is produced from 50 to 150 lb.-ingots. Smooth surfaces are important. Some ingot defects are due to faulty melting practice. The crystal structure of ingots is a factor in sheet production. JLG(12c)

The Pass Design of Reducing Rolls for Seamless Tubes. (Die Kalibrierung der Reduzierwalzen für nahtlose Rohre.) P. GOROL. *Stahl und Eisen*, Vol. 51, Jan. 8, 1931, pages 33–37.

Report 82 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The economic superiority and the technical disadvantages of cross rolling processes are discussed. The disadvantages of this rolling method are that the wall thickness of the tube increases non-uniformly in passing through the passes, the material is frequently out of round; changing of the numerous rolls of this type of mill requires much time. To counterbalance these disadvantages, various remedies are discussed. In the first place, it is advisable to diminish the wall thickness by the amount it increases during rolling. The reduction from pass to pass must be much smaller than the average reduction in rolling full round shapes. The rolling speed must be equalized so as to obtain a tension between 2 subsequent passes. The passes should be made somewhat oval. Careful supervision of all individual parts of the mill is most essential for successful operation. GN(12c)

Building Forming Mill for 26-inch Welded Pipe. *Steel*, Vol. 87, Aug. 14, 1930, page 54.

Describes mill built by the Yoder Co., Cleveland, Ohio. Mill is of the 2-high continuous type, consisting of 12 stands and is designed to roll pipe 18–26 in. in diameter with wall thicknesses up to $^3/_4$ in. at a speed of 100 ft./min. First 5 stands are provided with horizontal rolls only, while the last 7 have both horizontal and vertical rolls. The rolls are of hardened and ground cast-steel. MS(12c)

Forces Acting on Roll-Neck Bearings. W. TRINKS & J. H. HITCHCOCK. *Rolling Mill Journal*, Vol. 4, Oct. 1930, pages 531–536; Nov. 1930, pages 623–628.

From paper read before the American Society of Mechanical Engineers, Sept. 22–24, 1930. See *Metals & Alloys*, Vol. 2, May 1931, page 106. MS(12c)

Modernization of Existing Hot Sheet Mills. R. J. WEAN (Wean Engineering Co., Inc.). *Rolling Mill Journal*, Vol. 4, Dec. 1930, pages 659–661.

Developments such as continuous pack- and pair-heating furnaces, mechanical feeders and catchers, and continuous hot-mill polishers have permitted conventional type sheet-mills to utilize present investment, maintain employment, and operate at a profit. MS(12c)

The Base Metal Rolling Mill of the International Silver Company. F. A. WESTBROOK. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, pages 551–553.

Describes the operations of rolling nickel silver and pewter. VSP(12c)

Overcoming Difficulties in Rolling Structural Shapes. HAROLD HARRIS. *Rolling Mill Journal*, Vol. 4, Oct. 1930, pages 553–555.

Discusses causes of cambering, finning and cobbling and methods of overcoming such difficulties. MS(12c)

Expansion and Contraction of Sheet and Tin Plate Mill Hot Rolls. HAROLD HARRIS. *Rolling Mill Journal*, Vol. 4, Aug. 1930, pages 431–433.

Discusses causes of roll breakage and their avoidance by proper rolling practice. Most frequent cause of breakage is overheating of the rolls, which results in excessive expansion. Another cause is the gagging of bars in rolls, which is due to backlash or too loose a top roll. Other causes are excessive draft and rolling with hot or dry necks. MS(12c)

Recent Developments in Cooling Table Construction. MAX CURTH. *Rolling Mill Journal*, Vol. 4, Dec. 1930, pages 691–694.

Concluding installment of a translated abstract of a report of the Walzwerksausschuss des Vereins deutscher Eisenhüttenleute. MS(12c)

Forging (12d)

Stainless Steel and Its Properties. CARL S. SMITH (Republic Steel Corp.). *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1403–1405, 1408; Condensed in *Steel*, Vol. 87, Oct. 16, 1930, pages 45–46; *Machinery*, London, Vol. 37, Dec. 11, 1930, page 360.

Paper read before the American Drop Forging Institute, Oct. 9–11, 1930. Cr steels are easily coarsened by heat, are brittle when cold unless properly treated or alloyed, and have poor heat conductivity. It requires 2–3 times more power to work these alloys than ordinary C steel. Most satisfactory surface for forging is turned bar stock. Important points to be observed are: Clean steel inside and upon the surface; heating cycles that provide for preheat below the grain growth range in the simple Cr steels and below the carbide precipitation in the Cr-Ni steels; rapid controlled heating from the preheat to the working temperatures and positive fast work while hot, keeping in mind that the cold working ranges begin much higher than in simple steels while the top temperatures for working are no higher; and scrupulous inspection for surface defects to insure that any trapped scale is removed. Cutlery is heated to 1800° F., quenched in oil and drawn. In the Cr-Ni steels, maximum corrosion resistance is obtained by heating rapidly to 2100° F. and quenching sections of more than $^1/_{16}$ in. in H_2O. This treatment prevents precipitation of carbides which lower corrosion resistance. Highest temperature during forging of Cr-Ni steels should be kept below 2350° F., to prevent precipitation of the δ-phase. MS(12d)

Extruding (12f)

Lead Wire, Its Manufacture and Use. J. A. McDonald. *Wire & Wire Products*, Vol. 6, May 1931, pages 174–175.

Description of production methods of the Northwest Lead Co., Seattle, Wash. The wire is mostly extruded from hydraulically operated presses at 500 to 1000 tons pressure. Lead pipes are also made in this way. Lead coating by spraying and burning of lead for joints is described. Ha(12f)

Machining (12g)

The New Alloys and Machine Tool Design. Part III. Francis W. Shaw. *Metallurgia*, Vol. 3, Feb. 1931, pages 131–134.

Discussion of multiple tools, efficient planning and use of inserted teeth cutters. JLG(12g)

The Influence of Different Methods of Finishing on the Structure of the Surface Zone in Cast Iron. (Ueber den Einfluss verschiedener Bearbeitungsverfahren auf das Gefüge in der Randzone von Gusseisen.) W. Schilken (Esslingen Maschinenfabrik). *Mitteilungen aus den Forschungsanstalten, Gutehoffungshütte Konzern*, Vol. 1, April 1931, pages 92–100.

Very rapid wear on well lubricated co-acting rings of an ammonia compressor, used instead of a stuffing box, made of 200 to 220 Brinell gray iron had to be overcome. Iron of 180 Brinell, hard iron, annealed iron, hardened steel and bearing metal were all tried with no better results. Hence the method of finishing was studied. Turning cast iron with tool steel, high speed steel, tungsten carbide tools, grinding, honing and lapping were studied. Microscopic examination of the surfaces indicated that tiny cracks extended down through phosphide areas to graphite particles, leaving pieces ready to break out, if the rings were turned in the usual way. Stresses are introduced through distortion by slow turning that results in cracks. It is concluded that a pearlitic structure, very fine graphite, preferably almost of the fineness of temper carbon, and absence of phosphide are required. Such a material, turned at high speed with tungsten carbide tools, gives a surface without cracks. The article is profusely illustrated, the illustrations taking as much space as the text. HWG(12g)

The Machining of Aluminum and Its Light Alloys. (Nota sur alcune questioni inerenti la lavorazione meccanica delle leghe leggere e dell' alluminio puro.) U. Magnani & C. Panseri. *La Metallurgia Italiana*, Vol. 9, Apr. 1931, pages 265–291.

This article contains 72 figures, 16 tables, 19 footnotes and 32 bibliographic references. Types of tools and tool angles, speeds and feeds for drilling, planing, milling, turning, tapping, cutting off and filing are discussed in detail for machining aluminum, the Al-Si alloys and the duralumin type of alloys, with some consideration given to electron, bronze, steel, cast iron, high silicon irons, Mn steel, etc. Tungsten carbide, stellite and diamond tools are touched upon, as are grinding wheels. So much of the information is given in the figures that the original should be consulted. HWG(12g)

Lubricants and Cutting Fluids. A. H. d'Arcambal. *Wire & Wire Products*, Vol. 6, May 1931, page 171.

Cutting of metals is done in the following ways: (1) dry, without any fluid, but sometimes with an air blast; (2) watery solutions, sometimes containing an alkali; (3) emulsions, soluble oils; (4) oils, i. e., fixed oils, mineral oils, compounded oils, sulphurized mineral oils. For general machining, except threading, sulphur base oil should be used. For lathe turning, emulsion oil with 20 parts of water is suggested. For threading amber fluid containing about 1% of sulphur is advised. Ha(12g)

New Tools Successfully Cut High-Manganese Steels. Walter R. Breeler (Whitman & Barnes, Inc.). *Steel*, Vol. 87, Aug. 7, 1930, page 67.

A twist drill made of Co high-speed steel has been developed for drilling Mn steel. The point is given a 68° angle, the cone angle is 120°, and the lip clearance, 6–8°. To strengthen the cutting edge, a flat section is ground on the lips. Drilling machine must have a positive feed and speed mechanism powerful enough to drive the drill through. Peripheral speed of the drill should be 12–15 ft./min. Hole should be drilled through in one continuous cut. On deep cuts, it is practical to drill the hole intermittently or to cool the drill in oil. MS(12g)

Regulation of Particle Size Promises Added Strength. W. H. McCoy (General Motors Corp.). *Steel*, Vol. 87, Oct. 16, 1930, pages 48, 55.

Paper read before Society of Automotive Engineers at Detroit, Oct. 7–8, 1930. See "The Future of Tungsten Carbide as a Cutting Tool," *Metals & Alloys*, Vol. 2, Feb. 1931, page 43. MS(12g)

Drawing & Stamping (12h)

Ford Rustless Steel Radiator Shells Need 17 Press Operations. J. Geschelin. *Automotive Industries*, Vol. 63, July 12, 1930, pages 44–46, 48.

Illustrated description of the finishing operations of Allegheny metal parts used in the Ford cars. GN(12h)

Production Determines Value of Tungsten Carbide Dies. H. R. Simonds *Steel*, Vol. 87, Aug. 28, 1930, pages 50–51.

Igoe Bros., Newark, N. J., uses three types of dies: (1) 18-hole draw-plate made of high-grade forged steel containing 18% Cr and a small amount of Ni; (2) cast blocks of high-grade, high-C Fe, chilled in the mold, with 12–15 holes; and (3) single-hole block made of high-C steel and lined with tungsten carbide. The last draws 1/4 in. low-C wire rod down to 0.199-in. wire in one operation. A single die produces approximately 200,000 lbs. of wire and gives a better finish to the product. The initial cost of the tungsten carbide die is, however, 6 times that of the forged-steel plate, and the grinding costs are much higher. MS(12h)

Carbide Dies Advancing the Art of Wire Drawing. L. D. Granger (Wickwire Steel Co.). *Iron Age*, Vol. 127, Jan. 1, 1931, pages 40–41.

Application of tungsten carbide in continuous wire drawing, with careful study of angles, bearings, reduction and lubrication have made wire drawing a more exact process. Advantages include increased production, lower power costs and reduction in mill rejections. Carbide dies must be of suitable grade, of proper shape and have sufficient material to withstand stresses without breakage. VSP(12h)

The Dick Pressing Process and the Inverted Pressing Machines. (Das Dicksche Pressverfahren und die umgekehrt arbeitenden Pressen.) O. Busse & Cl. Busse. *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 105–113.

The paper was presented before the Deutsche Gesellschaft für Metallkunde, Berlin, 1930. The replacement of the rolling process by mechanical and hydraulic pressing operations is considered and the historical development of the latter reviewed. The direct and inverted processes are critically discussed and the results of an all-round inquiry concerning the experiences of the various plants are given. The advantages of the inverted process are emphasized. Includes discussion. EF(12h)

Forming of Metals. (Spanlose Formung der Metalle.) G. Sachs. Julius Springer Verlag, Berlin, 1931. Cloth, 8 1/2 × 11 3/4 inches, 127 pages. Price 28 R. M.

This is a collection of articles by Sachs and co-workers on the forming of metals without cutting, i. e., by inducing plastic flow.

They relate to deep-drawing, wire-drawing, extrusion and to indentation methods of hardness testing. The mechanics of the processes are considered in detail.

Much more attention seems to be given to the fundamentals of these forming processes in Germany than in any other country so far. At least, the publications from other than German sources are very rare. The work of Sachs and his co-workers deserves careful attention, hence this volume should be of interest to many American readers.

The articles will appear also in Sonderheft 16 of *Mitteilungen der deutschen Materialprüfungsanstalten*. The individual articles will be abstracted, instead of discussing the whole group of articles here.—H. W. Gillett (12h)-B-

Construction of the Metal Airplane. G. H. Prudden (Keystone Aircraft Corp.). *Preprint* for May 1931 meeting, Aeronautic Div., *American Society of Mechanical Engineers*, 6 pages.

The author predicts very much lower cost in the construction of metal planes, although in the past this cost has been high due to small production of any one model. Dies for quantity production of formed metal parts are extremely expensive, and while it has been recognized that when production is large enough to allow distributing this die cost, metal construction will be cheapest, with present outputs the cost of ordinary die processes is prohibitive. The author, however, by "re-discovering" the soft metal die process, has opened the way to dies cheap enough so that the hand forming process can be beaten in cost even though only a few pieces are to be made. A clay pattern is swept up and modeled. From this a plaster cast is made, which serves as the pattern for a cast Zn die. This die is aligned under a drop hammer, and a Pb base cast around it which locates it as to holes in the anvil. The other half of the die is made in place under the hammer by building a dam about the lower half, pouring on antimonial lead, and lowering the hammer to meet it. The clearance is obtained by inserting a black iron sheet of the same thickness as the duralumin to be stamped and stamping that, which forces the clearance into the soft metal. Or a Zn casting is made with the lower half as the pattern, shrinkage producing the clearance. Such a casting of the upper half is then fastened onto the hammer with lead as before. As compared with hand forming, this plan has saved 30% of the man hours in the fabrication of a metal plane. HWG(12h)

Electric Equipment for Wire Drawing. T. R. Rhea. *Wire & Wire Products*, Vol. 6, May 1931, pages 165–170.

Discusses in detail the various types of motors suitable for wire drawing machinery and their control. Ha(12h)

Cold Working (12j)

Treatment of Cold-Rolled Non-Ferrous Metals. (Behandlung kaltgereckter Nichteisenmetalle.) W. Wunder. *AEG-Mitteilungen*, Vol. 4, May 1931, pages 331–335; *Metallwirtschaft*, Vol. 10, May 1, 1931, pages 357–359.

Although it has long been known that cold-rolled non-ferrous metals, in some cases, become defective after some time, proper means are often not employed during manufacture to guard against losses of this kind. It is pointed out that cold-rolled material must, in any case, be heated to a temperature below the lower recrystallization temperature to protect them against forming cracks and to give them the best resilient qualities. A number of illustrations show materials which have developed such defects after cold-rolling. CEM+Ha(12j)

Strain Hardening of Some Materials during Cold Rolling. (Die Verfestigung einiger Werkstoffe beim Kaltwalzen.) E. Greulich. *Zeitschrift für Metallkunde*, Vol. 23, Mar. 1931, pages 91–93.

The exponential function which was found to govern the strain hardening of steels and Monel metal in relation to the deformation, could also be ascertained in case of Fe, Cu and brass (70/30) down to deformations by rolling of 30%. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 44. EF(12j)

High Edge or Flat Edge Straightening of Rails? (Hoch- oder Flachkantrichten der Schienen?) A. Lobeck. *Stahl und Eisen*, Vol. 51, Jan. 29, 1931, pages 128–129.

In investigating the various methods of straightening rails, it was found that the high edge straightening unfavorably affects foot and flange of the rail. Flat edge straightening is more favorable. GN(12j)

Cleaning (12k)

The Water Cleaning of Castings. (Das Gussputzen nach dem Wasserstrahlverfahren.) C. Gertreudts. *Giesserei Zeitung*, Vol. 27, Dec. 1, 1930, pages 633–636.

The cleaning of castings by means of high-pressure water offers essential economic advantages. GN(12k)

Removes Scale from Surface of Metal without Pitting. H. R. Simonds. *Steel*, Vol. 87, Nov. 6, 1930, pages 61, 63.

Describes Bullard-Dunn process for electrochemical cleaning of steel. Work to be cleaned is immersed for several minutes in a tank containing a solution of H_2SO_4, HCl and NaCl, given a quick wash in hot water, and immersed in an alkaline bath. Both the acid and alkaline tanks are equipped with means for electrifying the bath. The anodes are suspended along the sides, while the parts to be cleaned hang from heavy Cu cathodes at the center. All the electrodes in the acid tank are of Pb. In the alkaline tank, half the electrodes are Pb and the other half, Fe. Current of 60–100 amp./ft.^{2} at 6 volts is used. A clean Pb coated surface is produced in less than 5 min. The alkaline tank is equipped with a reversing switch which changes the direction of the current for the removal of the Pb coating, when desired. Pb coating protects steel from attack by acid. MS(12k)

Polishing & Grinding (12l)

Mechanical Methods for Producing a High Polish. (Das mechanische Hochglanzpolierverfahren.) Karl Becker. *Deutsche Goldschmiede-Zeitung*, Vol. 34, Apr. 11, 1931, pages 157–158.

A discussion of metals and machines used for polishing gold and silver ware. JLG(12l)

New Plant Can Polish 30 Tons of Chrome-Nickel Sheets Daily. E. F. Ross. *Steel*, Vol. 87, July 24, 1930, pages 43–45, 58.

Describes equipment and operations at the plant of the Republic Steel Corp., Massillon, Ohio. Equipment can handle normally sheets 60 in. wide and 168 in. long in thicknesses from 25 gage down to 1/4-in. plate. Sheets are first rough ground on machines equipped with a No. 80 abrasive belt, speed being 1400–1650 ft./min. Polishing is done on machines equipped with oscillating rolls 18 in. in diameter, coated with No. 100–220 abrasive, depending upon the surface finish desired. Speed is about 350 r. p. m. Special finishes can be supplied also. After polishing, the sheets are cleaned thoroughly by rubbing down with whiting. Sheets intended for exterior use are cleaned and pickled for 30 min. in 20–25% HNO_3 at 130° F. Pickling tanks are made of welded 18–8 Cr-Ni steel. MS(12l)

Diversity of Advice Clouds Problem of Polishing Stainless Steel. F. W. STURDEVANT. *Steel*, Vol. 87, Dec. 25, 1930, pages 48–49.

Original surface should be smooth in order to obtain mirror finish. Small articles are readily buffed with a fine count buffing wheel at a peripheral speed of 10,000–15,000 ft./min., cutting down with special composition made for the purpose and coloring with Cr_2O_3. Abrasive should be absolutely uniform and free from slivers and flats. Tallow or lard oil should be used on the wheels with each operation. For preparing surfaces to be buffed, a 14 in. soft muslin wheel, at 1750 r. p. m. with suitable grit is used. On some makes of wide sheets, nos. 80, 120, 150 and 180 abrasives are used in sequence. The sheets are then brushed with a Tampico wheel, with No. 200 emery cake applied locally, buffed and colored. Cutlery after being ground is passed between 2 polishing wheels of the compress type. Automatic mirror finishing machines are now used for buffing the blades. MS(12l)

The Grinding of Tools with Cutting Edges of Krupp's Tool Metal "Widia." (Ueber das Schleifen von Werkzeugen mit Schneiden aus Kruppschem Werkzeugmetall "Widia".) BRUNO LEDER. *Krupp'sche Monatshefte*, Vol. 12, Mar. 1931, pages 39–56.

The cutting capacity of the metal "Widia" depends, to a very great extent, on the proper shape of the cutting edge and its exact grinding. A table gives the cutting angle and the angle of the cutting edge for various hard metals. Numerous illustrations show the machines and methods for proper grinding of millers, planers, drills, etc. Ha(12l)

An Experimental Study of Metal Polishing by Flexible Polishing Wheels. EDWIN M. BAKER & GEORGE E. HOLBROOK. *American Electrochemical Society, Preprint* 59–31, April 1931 meeting, 16 pages.

This paper describes the apparatus which was designed and built at the University of Michigan for the experimental study of metal polishing by flexible polishing wheels, outlines the general procedure of the laboratory tests, and presents experimental data which were obtained in a study of the following problems: The determination of the effect of variations in pressure upon the performance of the wheels; the determination of the effect of variations in grain screen analysis and glue concentration upon performance; the determination of the changes of performance of a wheel as it is used in the polishing process; and the determination of the effect of applying a thin film of glue to the periphery of the wheels after all the grain has been applied. (12l)

Coloring (12m)

Process for Coloring Aluminum. *Brass World*, Vol. 27, Apr. 1931, page 82.

The process for finishing aluminum products in a variety of colors is described in literature of the Aluminum Coloring Corp., Indianapolis, Ind., operators of the "Alumilite" process under license of the Metals Protection Corp., Indianapolis, Ind. Color coatings which consist of a dyed oxide film 0.0004" thick, are hard and quite resistant to abrasion, this resistance being more than five times greater than five coats of baked enamel. WHB(12m)

DEFECTS (13)

Hot Cracks in Cast Steel. (Ein Beitrag zur Warmrissbildung an Stahlgussstücken.) K. SINGER & H. BENNEK. *Stahl und Eisen*, Vol. 51, Jan. 15, 1931, pages 61–63.

After considering the literature on the formation of cracks in cast steel, practical examples are dealt with. The possibility of closing cracks which originate during the solidification is proved by microscopic examinations. The process of shrinkage has been studied as well as the stresses which are set up in various cross-sections. A remedy for avoiding cracks is the proper regulation of the cooling conditions. GN(13)

Fatigue Failures. *Automobile Engineer*, Vol. 20, July 1930, page 254.

Brief general discussion of the effect of sharp angles, keyways, stamped inspection numbers and notches on the fatigue failure of metals. RHP(13)

The Causes of Some Defects Observed on Brewery Apparatus of Aluminum. (Ueber die Ursachen einiger an Aluminium-Brauereigefässen beobachteten Schäden.) G. ECKERT. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Nov. 1930, pages 191–194.

Most failures are due to unsuitable material, defective erection and improper use of the apparatus. The first reason is almost eliminated nowadays as aluminum can be produced with a very high degree of purity. The other reasons are discussed and means for their elimination described. Ha(13)

Preventing Defects in Brass Castings. WILLIAM J. REARDON. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, page 554.

Examination of defective casting showed shrinkage at the place where it leaked. Cause of defect was that heavy sections stay fluid longer than thin sections and light sections draw the metal from the heavy sections. Examination of another casting showed that it was spongy. This was caused by filling mold with metal of incorrect temperature, by core giving off too much gas and by incorrect melting of metal. Suggests remedies. VSP(13)

The Inverse Segregation in Aluminum-Copper Alloys. (Ueber die umgekehrte Blockseigerung von Aluminium-Kupfer-Legierungen.) H. BOHNER. *Aluminium, Hauszeitschrift der V. A. W. Erftwerk*, Vol. 3, Jan.-Mar. 1931, pages 3–19.

Certain aluminum alloys which solidify as solid solutions over a larger temperature range have the tendency to an inverse segregation, i. e., in such castings, the outer part has a higher, and the center a lower, percentage of the alloyed material than would correspond to the actual composition of the alloy. In a normal segregation, conditions are reversed. The paper, after exhaustive experiments, discusses the reasons for such phenomena as are dependent on composition of the alloy; conditions of casting and pouring; temperature of the metal and molds; pouring velocity; heat conduction, which exerts the greatest influence; and dimensions of the mold. The chemical and metallographic examination of the test pieces show a certain regular influence of composition and velocity of solidification. To obtain a satisfactory casting and to avoid segregation and also pipes, the Fe content must be less than 0.5%. The additions of Mn, Si and Ti must not exceed certain percentages as otherwise, in the center of the casting, larger and more brittle segregations of crystals take place which have a harmful effect on further working. The experiments will be continued particularly with regard to the influence of great velocities of solidification. Ha(13)

Cause of Rail Fractures. (Beitrag zur Klärung der Ursache von Schienenbrüchen.) H. BERCHTENBREITER & F. DOLL. *Organ für die Fortschritte des Eisenbahnwesens*, Vol. 85, July 1930, pages 225–229, 17 illus.

Investigations on a large scale disclosed the influence of wheel pressure upon rail fractures. The presence of surface defects on the rail-base is stressed and the influence of low temperatures discussed. EF(13)

Why Metals Fail. H. F. MOORE. *Product Engineering*, Vol. 2, Apr. 1931, pages 164–166.

A general discussion of strength of metals and the reason for defects and the means of detecting defects. Ha(13)

Failure of Machine Members. L. T. HOLT. *Machine Design*, Vol. 3, June 1931, pages 41–43.

In the opinion of the author, notch fatigue, insufficient heat treatment and tool marks are some of the principal causes of failure. Inclusions and segregations of phosphorus are usually found in defective pieces; micrographs of several samples show such conditions. Ha(13)

CHEMICAL ANALYSIS (14)

Analysis of Remelt Aluminum. *Metal Industry*, N. Y., Vol. 28, Dec. 1930, page 553.

Describes results of a meeting of chemists representing members of Aluminum Research Institute at Cleveland to consider progress made to establish method of analyzing remelt Al and its alloys. VSP(14)

Some Observations on the Estimation of Silicon in Pig and Cast Iron. H. W. KEEBLE. *Iron & Steel Industry & British Foundryman*, Vol. 3, Sept. 1930, pages 367–368.

Methods for determining silicon in pig iron and gray and malleable iron castings; analysis is modification of Brown's method using sulphuric acid. CHL(14)

Different Methods of Determining Sulphur in Steels. (Différentes méthodes de dosage du soufre dans les aciers.) A. GUEDRAS. *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Feb. 1931, pages 75–80.

This method is based on the same principles as determining carbon by combustion in oxygen atmosphere. The furnace is kept at 1200° C., a 2 g. sample placed in the furnace, a current of O_2 passed over the sample and the SO_2 gas is absorbed in H_2O_2 and NaOH solution which is titrated with H_2SO_4. GTM(14)

The Preparation of Pure Electrolytic-Nickel. Part III. Chemical and Physical Properties. COLIN G. FINK & F. A. ROHRMAN. *American Electrochemical Society, Preprint* 59–37, April 1931 meeting, 10 pages.

After having prepared samples of purified Ni as described in the first two parts of this research, it was necessary to analyze them for any impurities that might not have been removed. The ordinary scheme of chemical analysis could have been followed in two ways: the purity of the Ni might have been determined directly by a careful Ni analysis and the impurities found by difference, or the impurities could have been determined directly. The former requires specialized technique of extreme accuracy, and the latter would be an almost hopeless task. Normally, chemical means are not specific and require reagents, the purity of which cannot always be guaranteed. On the other hand, spectrographic analysis, especially in the case of the metals, is specific and requires no reagents. Another great advantage of spectrographic analysis is that it records the metallic impurities, expected or otherwise, and gives a permanent record of the analysis. (14)

Possible Use of the Poulsen Arc as a Means of Detecting Traces of Impurities in Metals. HARRY E. REDEKER & PHILIP A. LEIGHTON. *Journal American Chemical Society*, Vol. 52, Oct. 1930, pages 4169–4170.

Results of preliminary tests show that the use of the Poulsen arc serves as a means of detecting small traces of impurities of even atomic number in such metals as Cu, Au and Ag. MEH(14)

Handbook of Chemical Microscopy. Vol. 2. Chemical Methods & Inorganic Qualitative Analysis. E. M. CHAMOT & C. W. MASON. Wiley & Sons, New York, 1931. Cloth, 6¼ × 9¼ inches, 411 pages. Price $4.50.

Time is worth saving, in qualitative chemical analysis, as in any other technical operation. Occasions arise from time to time in which an analysis is needed on material too scanty in amount for an analysis by ordinary methods. The skilled chemical microscopist can, for example, rub off from an alloy sample an almost weightless streak on a fragment of unglazed porcelain, dissolve that trace of alloy, place a tiny drop of the solution on a microscope slide, add a suitable reagent, and in a twinkling tell with certainty from the appearance under the microscope of the crystals formed whether a certain metal sought is present or not. The convenience of the microchemical method makes it of great value wherever qualitative analysis is required.

Professor Chamot is the greatest living authority in this field, and most Americans skilled in it have gotten their skill directly from his instruction, or from being taught by those whom he has instructed. The methods deserve even wider use and appreciation. Chamot's previous book helped toward this, and the present edition by himself and his disciple, Mason, will help still more. It contains some 160 photomicrographs of the crystals produced by the reactions used, just as one sees them under the microscope, together with details of the micro-manipulation and discussion of the reactions involved.

The authors point out the limitations of the methods and do not claim a bit more for them than is deserved. Interferences by other elements than the one sought are pointed out. In many cases, however, the reagent used is specific; when it produces a given sort of crystal, it shows that the one element sought is present. This is in great contrast to the complex separations so often necessary in the usual schemes of qualitative analysis, and is the reason for the vast time saving realized when the micro method is applicable.

Many years of patient work were required to establish the conditions under which reliable specific tests are possible. The fruit of these many years of labor is given in this book.

It is unlikely that the average chemist could become a really skilled microanalyst by merely studying the book without some other instruction, but with a few weeks training such as is given by Chamot and Mason in summer school, he could, with the help of this book, handle almost any microchemical problem. It would pay many a firm to give some one of their analysts such training. It is to be hoped that many other universities will follow the lead of Cornell, now that such a complete text-book is available, and introduce a course in micro-analysis, so that a greater number of competent microanalysts will be trained.

The reviewer took the course under "Chammy" 25 years ago, and still classes it as one of the most interesting and useful courses ever offered to the chemist. His own observations of the applications of micro-chemistry lead him to believe that every metallurgical laboratory should have at least one analyst skilled in micro methods. The methods, and this book describing them, are most highly to be recommended.—H. W. Gillett (14)–B–

The Application of the Potentiometric Analysis in Steel Mill Laboratories. I. The Determination of Manganese, Chromium and Vanadium. (Die Anwendung der potentiometrischen Mass analyse im Eisenhüttenlaboratorium. I. Die Bestimmung von Mangan, Chrom und Vanadin nebeneinander.) P. DICKENS & G. THANHEISER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 14, 1930, Report 158, pages 203–223.

The principles of potentiometric titration, the most common methods and the manifold possibilities of application are considered. See *Metals & Alloys*, Vol. 1, July 1930, page 634. GN(14)

The Limits of Determination of Some Heavy Metals by Drop Reaction with Dithizone. (Die Erfassungsgrenzen für den Nachweis einiger Schwermetalle durch Tropfenreaktion mit Dithizon.) H. FISCHER. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 99–107.

Dithizone (Diphenyl-Thiocarbazone) has proved to be quite remarkably well suited for the qualitative recognition of very small quantities of heavy metals which, for most purposes of the analytical practice, is entirely sufficient. This is due to vivid coloring and the ready solubility in organic solvents, though insoluble in water. The following sensitivities were found: for Zn, 1:2,000,000; Cu, 1:1,660,000; Ag, 1:1,000,000; Pb, 1:1,250,000; Co, 1:1,250,000 (all in neutral solutions); for others, the sensitivity is smaller but still very pronounced. The method is especially suitable for micro-chemical work. Ha(14)

HISTORICAL & BIOGRAPHICAL (15)

From Welding Craftsmanship to Welding Technique. (Von Schweisshandwerk zur Schweisstechnik.) OTTO MIES. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 50–51.
An historical review of the development of methods and apparatus, and a program for future progress. Ha(15)

Dr. Herty Discusses Steel-Making. *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, page 1610. **Chemistry Aids Steel-Making Processes by Determining Substances in Steel.** *Steel*, Vol. 87, Sept. 4, 1930, page 45
From a report by C. H. Herty, Jr. to the Iron & Steel Section of the National Research Council Science Advisory Committee, which is working on plans for an iron and steel exhibit at the Chicago World's Fair in 1933. Outlines history of scientific investigations on steel-making processes. From 1860 to 1877, considerable attention was given to gases in steel. Much work was done on dephosphorization from 1877 to 1899. During 1889 to 1902, desulphurization received a great deal of attention. The effects of O in steel began to be appreciated and investigated during 1902 to 1912. Further investigations of O in steel were made and new methods devised for the determination of oxides during 1912 to 1922. From 1922 to 1930, increasing attention was paid to O in steel, with particular emphasis on the various types of O compounds present. MS(15)

Origin of Stainless Steels and Alloys. J. FERDINAND KAYSER (Darwin's, Ltd.). *Metallurgia*, Vol. 3, Feb. 1931, pages 135–136; *Steel*, Vol. 89, Mar. 19, 1931, page 55.
From a lecture to the Rotherham Technical Institute Engineering Society. Briefly reviews development of stainless alloys. JLG(15)

Investigation of Pre-Roman Raw Steel. (Untersuchung von Rohstahl aus der vorrömischen Zeit.) H. HANEMANN. *Stahl und Eisen*, Vol. 51, Jan. 15, 1931, pages 67–68.
A lump of raw steel dated from the La Tène period was examined metallographically and chemically. Forging tests indicate that the working of this steel must have offered difficulties. This piece of steel, over 2000 years old, shows the stability of cementite. GN(15)

ECONOMIC (16)

Zinc Industry in Poland. *Metal Industry*, London, Vol. 37, July 4, 1930, page 10.
Poland occupies third place in the world's production of Zn. Chief center of production is upper Silesia, which supplies about 85% of the total output. Home consumption is about 20%. Germany uses about 1/2 of the total Zn exported from Poland. VSP(16)

Steel Residences—Is This Market Appreciated? *Steel*, Vol. 87, Oct. 16, 1930, pages 50, 53, 55; Oct. 23, 1930, pages 57–59; Oct. 30, 1930, pages 54–55.
Outlines history of steel-frame construction for residences, describes the promotional program of the Steel Frame House Co., and draws conclusions as to the market possibilities of the future. On the basis of an average of 9 tons of steel per house, it is estimated that the total possible market for structural steel would be 2,700,000 tons annually. MS(16)

The Cycles of Prices of Non-ferrous Metals. LUDWIG VOGELSTEIN. *Bulletin* 216, *Mining & Metallurgical Society of America*, Jan. 1931, pages 2–17.
The Chairman of the Board of the American Metal Co., Ltd., first clarifies the meaning of generally loosely-employed terms such as business cycles, boom and depression times, etc., and lays stress on the fact that the cyclical movement of metal prices, production and consumption, is closely bound up with general business conditions; also that the argument that high prices do not check consumption is fallacious. Cyclical movements in the field of economics can defy temporarily the laws of demand and supply. The importance of the quantitative gold theory is exaggerated by those who favor it. 8 metal price and consumption charts are given and discussed in detail. MFB(16)

Group Research Among Gold Producers. R. M. P. HAMILTON. *Engineering & Mining Journal*, Vol. 131, Apr. 27, 1931, pages 356–358.
A plea is made for coöperation in the attainment of a greater standardization of technical efficiency and economical operation among the gold producers in Northern Ontario, along the lines of the successful effort in this direction in the Witwatersrand district, Transvaal and along the Golden Mile in Western Australia. Direct operating costs and metallurgical results of nine mills are tabulated and a flow sheet shown for a 500-ton combination flotation and cyanide plant. Some of the successes of the group research plan in the Transvaal and in Western Australia are touched upon. WHB(16)

Compensating Grinding Costs for Varying Billet Size. L. C. GRIFFIN (Precision Grinding Wheel Co., Inc.). *Steel*, Vol. 87, Aug. 28, 1930, pages 54, 56.
Outlines practical method by which the tonnage ground in the billet grinding departments can be figured on a fairer basis. Points out the importance of billet size in the computation of grinding costs. Method is based on the fact that a billet 4 × 4 of any length has the same number of sq. in. grinding area as it has cu. in. volume. When grinding any other size billet, the actual weight of the billet should be multiplied by a factor, $\frac{\text{sq. in. grinding area}}{\text{cu. in. volume}}$ to obtain the weight which should be credited to the grinding room. MS(16)

Billet Sizes Regulate Grinding Costs. L. C. GRIFFIN (Precision Grinding Wheel Co., Inc.). *Steel*, Vol. 87, Sept. 18, 1930, page 54.
Explains how to apply author's method of computing grinding costs when various sizes of billets are ground. MS(16)

Budgeting Reduces Steel Plant Labor Turnover. L. C. EDGAR (Carnegie Steel Co.). *Steel*, Vol. 87, Sept. 25, 1930, pages 45–46.
From *Proceedings of the Engineers' Society of Western Pennsylvania*. MS(16)

Japan Seeking Recognition in Steel Production. G. H. AUPPERL (Tobatta Foundry Co.). *Steel*, Vol. 87, Dec. 4, 1930, pages 65, 67.
Japan now consumes about 2,550,000 metric tons of steel annually and exports more than 200,000 tons. Since 1907, demand has increased 5.5 times while producing capacity has increased 20 times. Three leading steel plants and the most important foundry have employed American and German consultants. About 60% of the equipment in these plants was manufactured in America and the balance was imported from Germany. The principal plant, the Imperial Steel Works, is owned and operated by the Japanese Government. It produces more than 1,000,000 tons of ingots annually. Gives some information about this plant and the Fukiai Works of the Kawasaki Dockyard Co. Bulk of raw material is imported. MS(16)

Some Fundamentals of Ship Pipe Welding. S. MATHESON. *Welding*, Vol. 1, July 1930, pages 596–598.
Economies could be obtained by replacing all screw fittings by welded pipe bends. Ha(16)

PLANTS & LABORATORIES (17)

Die-Casting in the Midlands. The Works of Metal Castings, Ltd., Worcester. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, pages 285–288.
A description of the works of the pioneer company in Great Britain to successfully manufacture pressure die castings in both light and heavy alloys. PRK(17)

Die Casting in Birmingham. *Metal Industry*, London, Vol. 37, Oct. 17, 1930, pages 361–363.
Describes works of Messrs. F. H. Adams (1926) Ltd. VSP(17)

Canada's New Refining Capacity. *Metal Industry*, London, Vol. 38, Apr. 17, 1931, pages 414–415.
A description of Ontario Refining Company's plant at Copper Cliff, the capacity of which is 120,000 tons per year. The capacity of the Canadian Copper Refiners, Ltd., plant at Montreal is 75,000 tons per year. PRK(17)

Recent Design of Quicksilver Plants. C. N. SCHUETTE. *Engineering & Mining Journal*, Vol. 131, Apr. 13, 1931, pages 316–318.
Activity in the mining of quicksilver has been well sustained and has resulted in several changes in equipment and metallurgy of reduction plants. Three types of furnaces are in common use—the old Scott furnace, the rotary kiln and the Herreshoff furnace. The Scott is unsuitable to intermittent operation and requires a reasonably dry feed. The Herreshoff furnace has the advantage of a higher fuel economy than the rotary kiln and no occasional shutdowns for relining are necessary. Dust elimination is discussed and several illustrations from installations at different mines are shown. WHB(17)

Continuous Cast-Iron Testing in the Engine Foundry of the Fried. Krupp Aktiengesellschaft. (Ueber laufende Gusseisenprüfung in der Landmaschinengiesserei der Fried. Krupp A. G.). W. STRUK. *Krupp'sche Monatshefte*, Vol. 12, Apr. 1931, pages 89–92.
This company occupies a special foundry laboratory for very close supervision of the production of cast-iron, malleable as well as gray iron. The equipment of the laboratory and the methods of testing and representation in diagrams of the tests made are described and illustrated. Ha(17)

Aims at Perfection in Malleable Castings. *Foundry*, Vol. 58, Dec 1, 1930, pages 66–71.
Describes new plant of the Columbia Malleable Castings Co., Columbia, Pa. VSP(17)

Reduces Production Costs with a New Steel Foundry. *Foundry*, Vol. 58, Dec. 15, 1930, pages 44–47, 59.
Describes the equipment and operation of recently erected foundry of the Lebanon Steel Foundry Co., Lebanon, Pa. VSP(17)

Fabricates Chemical Tanks from Chromium-Nickel Alloys. H. R. SIMONDS. *Steel*, Vol. 87, Sept. 25, 1930, pages 43–44, 60.
Describes manufacture of tanks made of 18% Cr and 8% Ni steel as carried out by the Downingtown Iron Works, Downingtown, Pa. Both riveted and welded tanks can be produced satisfactorily when the structure is uniformly austenitic. Riveting practice follows closely that required for careful work with C steel. Rivets are driven at temperatures of 1850–2100° F. A hydraulic riveter is used wherever possible. Both oxyacetylene and electric welding are used. Welding-rod material is similar to that of the base metal. Bare rods are used for oxyacetylene welding and coated rods for arc welding. MS(17)

Finishing 10,000 Pocket Knives Daily. H. R. SIMONDS. *Steel*, Vol. 87, Dec. 4, 1930, pages 43–46.
Describes manufacture of pocket-knives by Remington Arms Co., Bridgeport, Conn. Nearly all operations are on automatic or semi-automatic machines. Blades made from steel sheets containing 1.10% C. MS(17)

Steel Works of the Mannesmann Tube Works, Dep. Schulz-Knaudt, Huckingen. (Hüttenwerkanlage der Mannesmannröhren—Werke Abt. Schulz-Knaudt, Huckingen.) PAUL STERN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Dec. 13, 1930, pages 1689–1695.
A very detailed description of the steel plant comprising conveyors and storage equipment, sintering plant and 2 blast furnaces of 500 tons each in 24 hrs. The blast furnace gas is cleaned electrically in an Elga cleaner. 4 basic Bessemer converters and six 50-ton open-hearth furnaces are provided for steel production. The new steel is semi-finished in 4 rolling mills. A water gas welding plant can make cylindrical tanks of 50 ft. in length and plates of 2 3/4 in. The gas cleaners are for 275,000 m.³/hr., the initial dust contents of 18 g./m.³ is reduced to 0.02 g./m.³; heating value of the gas is 900 to 1000 kgcal./m.³ See also *Metals & Alloys*, Vol. 1, Sept. 1930, page 741. Ha(17)

Forty Years of Seamless Steel Tubes. H. R. SIMONDS. *Steel*, Vol. 87, Dec. 18, 1930, pages 43–46.
Describes plant and methods of the Ellwood Ivins' Steel Tube Works, Oak Lane, Pa. Production is at rate of 250,000 ft. a week. Product varies from 5 in. down to 0.015 in. in diameter, although bulk of output is confined to C steel tubes 1/64–2 in. in diameter. Hollow billets are first pointed and then given a draw or an anneal, depending upon the material and the nature of the draw. Mandrels are held stationary. For extremely small sizes, mandrel is omitted. Drawing operations are repeated until the tube is brought to the desired size. A heavy special drawing lubricant is used. Frequent annealing between draws is necessary. After each anneal, tubes are pickled and washed before drawing. For most steel, annealing temperature is 1400° F. and time is 10–30 min. For drawing Cr-Ni steel tubes, tungsten carbide dies are used, and mandrels made of specially chilled steel having a Brinell hardness of about 650. In this case, mandrels are allowed to follow inside the tube being drawn. To loosen the drawn tube from the mandrel, a tube expander has been developed. It exerts pressure by 3 sets of rolls at 8 different points around the circumference of the tube, resulting in a slight expansion of the tube. Alloy die, high in C with Cr and W, is used for most of the work. All dies and mandrels are Cr plated. MS(17)

Need Careful Heat Treatment in Making Rock Drills. H. R. SIMONDS. *Steel*, Vol. 87, Sept. 11, 1930, pages 48, 50, 54.
Describes practice of the Ingersoll-Rand Co., Phillipsburg, N. J. Drill bits are forged hot in a drill sharpener. Pistons and cylinders for air hammers are normalized, annealed in powdered mica, sand-blasted and ground. They are hardened by preheating in a Pb bath, then holding at a higher temperature in a second Pb bath, and quenching in brine at 75–85° F. They are drawn in an electric furnace and cooled in air. A large number of low-C machine steel parts including those of Bessemer screw-stock are heat treated by the aerocase process of cyaniding. MS(17)

Processing 3-Ton Wrought-Iron Balls—A New Departure. J. D. KNOX. *Steel*, Vol. 87, Nov. 13, 1930, pages 43–46.
Describes new plant of the A. M. Byers Co. at Ambridge, Pa., for the manufacture of wrought-iron by the Aston process. MS(17)

Sheet Maker Installs Modern Furnaces in Expansion. W. G. GUDE. *Steel*, Vol. 87, Sept. 11, 1930, pages 43–46.
Describes equipment of the Apollo Steel Co., Apollo, Pa. MS(17)

MISCELLANEOUS (20)

Examines Foundry Figures Graphically. H. A. SCHWARTZ. *Foundry*, Vol. 58, Aug. 15, 1930, pages 44–47.

Data is translated in % and plotted. The abscissas are accumulated % of heats to and including a given C content shown as the corresponding ordinate. It is likely that a given heat will be found higher or lower than the average and that a given heat differing from the average decreases as the difference from the average increases. Close control is represented by an approach of the lines to the horizontal and the precision of control may be measured by the slope of the line. These charts may be used to check work of chemists. Similar data can be plotted from variations in tool life to determine uniformity of product machined. VSP(20)

Analyzing Failure in Wire Rope with Steel Center. L. E. WYATT (American Cable Co.). *Steel*, Vol. 87, Sept. 4, 1930, page 48.

In cables with independent wire-rope center, overloading of the steel core is not the only, or even the chief cause of failure. Failure may be caused by internal wear. Constant pressure between strands and core causes wear which tends to nick the outer wires of the core. The points of reduced wire section are weaker against bending stress, invite a concentration of flexion, and eventually fail by fatigue. MS(20)

Dimensional Changes in the Manufacture of Electrotypes. N. BEKKEDAHL & W. BLUM. *Bureau of Standards Journal of Research*, Vol. 6, May 1931, pages 829–845.

This investigation was conducted by coöperation between the International Association of Electrotypers and the National Bureau of Standards. Electrotypes made under typical but carefully controlled conditions were measured after each step in the process. The results showed that each operation is likely to produce some change in dimensions. The largest and most variable changes are produced in curving. By controlling all conditions it is possible to produce plates that will register with each other within about 0.05%, though they will usually not have the same dimensions as the originals. (20)

The Development of an Electron Emitting Alloy. O. S. DUFFENDACK, R. A. WOLFE & D. W. RANDOLPH. *American Electrochemical Society, Preprint* 59–17, April 1931 meeting, 17 pages.

It was discovered that irregularities in the sparking voltage of spark gaps were due to non-uniformities in the composition of the electrode materials. Small inclusions of magnesium in the nickel alloy ordinarily employed for spark plug electrodes were found to be distributed at random through the wire and to affect the sparking voltages. A thorough investigation established a complete coördination between the sparking voltage of a gap and the work function of electron extraction from the cathode surface. The sparking voltage of a standardized gap increases when the thermionic electron emission of the electrode wire, measured under standardized conditions, decreases. After many experiments, a nickel alloy containing barium has been developed which is homogeneous in composition and readily reproducible. Spark gaps having electrodes made of this alloy have very constant sparking voltages. The alloy has marked electron-emitting properties that make it valuable for use in various electrical devices. Its uses in several ways are being developed. (20)

Steel Plant Lubrication. W. A. JAMES (Bethlehem Steel Co.). *Yearbook, American Iron & Steel Institute*, 1930, pages 121–147, includes discussion; *Blast Furnace & Steel Plant*, Vol. 18, June 1930, pages 964–967, 1028; condensed in *Iron Trade Review*, Vol. 86, June 12, 1930, pages 61–62; *Rolling Mill Journal*, Vol. 4, May 1930, pages 221–224; *Foundry Trade Journal*, Vol. 43, July 31, 1930, 76 pages.

Paper read before the American Iron & Steel Institute, May 9, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 804. MS+VSP(20)

Metal-Clad Synchronous Motors Latest Thing for Nitrate Plants. *Electrical Engineering*, Vol. 50, May 1931, page 339.

A 250-hp. Westinghouse synchronous motor is under construction for use in an atmosphere of fine nitrate dust. Resistance to the danger of nitric acid damage to its windings is afforded by making the motors metal-clad and supplying a slight static pressure inside to prevent ingress of harmful dust. Inclined fins on the metal enclosure throw off and guide along the most efficient route the cooling air supplied by the fan on the rotor. The motors are designed to operate on 550-volt, 60-cycle circuits and have synchronous speed of 450 r. p. m. A starting torque of 120% and a pull-in torque of 100% are claimed for these motors. WHB(20)

Standard Thicknesses, Weights and Tolerances of Sheet Metal (Customary Practice). *Bureau of Standards Circular* No. 391, Mar. 24, 1931, 32 pages, procurable from Superintendent of Documents, Washington D. C., 10¢ (stamps not accepted).

Compilation of commonly used sheet metal gages, with tolerances as to size, weight and thickness for various gages. It covers iron and steel, galvanized steel, Sn and terne plate, Cu, Al, Pb, Zn, Monel metal, commercial (high) brass, naval brass, gilding metal, cupro nickel, "nickel silver," the aluminum alloys 3 S, 17 S, 25 S and 51 S, with some data on phosphor bronze, wrought aluminum bronze, wrought manganese bronze, low and rich low brass. British, French, German and Japanese gages are also tabulated. HWG(20)

What Is the Economic Weight of Rail? *Railway Age*, Vol. 88, May 24, 1930, pages 1231–1237.

An exhaustive study of the Kansas City Southern covering a period of 2 years has resulted in the substitution of a 137-lb. rail section for the 85-lb. section. The comparative physical properties of various rails is given in the following table:

Rail Section	Weight/Yd.	Tons/Mile	Moment of Inertia	Comparative Stiffness	Mean Carbon Content
85	85	133.6	34.0	100	0.70
100	101.5	159.5	49.0	144	0.75
115	114.4	179.8	64.0	188	0.75
127	127.3	200.0	83.7	246	0.81
150	150.5	236.5	121.1	356	0.85

All factors such as stresses under dynamic loading, service life, effect of rolling and rate of cooling for the different rails, volume of traffic, cost, maintenance, train resistance, etc., were considered and the following summary table prepared:

Summary Net Economic Value of the Different Rail Sections per Track Mile

Rail Section	Savings in Track Labor per million gross ton mi. of traffic	Savings in Track Renewals	Savings in Maintenance of Equipment	Savings in Train Operation	Total of Savings	Cost of Rails Place	Net Economic Cost	New Saving
85	$00	$00	$00	$00	$ 00	$190	$190	$ 00
100	46	4	14	8	72	198	126	64
115	64	8	26	14	112	197	85	105
127	71	10	34	18	133	200	67	123
150	84	13	44	21	162	230	68	122

VVK(20)

Movements in Metallurgy and Heat Treatment. GEORGE B. WATERHOUSE. *Iron Age*, Vol. 127, Jan. 1, 1931, pages 42–43.

In blast furnace practice, large hearth furnace installations were made; also better methods of gas cleaning were applied. Large number of automatic control devices for open-hearth furnaces were made. Installations of high frequency induction furnaces up to 3½ to 4 tons capacity. High Cr, 18 and 8, and similar steels were made by a cheaper process. Advance in heat treatment has been most marked in regard to furnace design and temperature control. Electricity, gas and oil used for heating with good results. VSP(20)

66-Ft Rails Prove Successful on the Lehigh Valley. *Railway Age*, Vol. 88, May 17, 1930, page 1173.

The Lehigh Valley relaid a total of 1000 tons or about 5 consecutive track miles of 33 ft. rails near Towanda, Pa., with 66 ft. rails of 136 lb. LV section. This had been suggested by the fact that the 33 ft. rails laid tight with no possibility of expansion, has given no trouble and also by the German State Railways practice of using 30 meter or 98.42 ft. lengths. No trouble was encountered from an expansion standpoint with these 66 ft. rails. VVK(20)

On the Cooling of Bodies with Internal Heat Sources. (Ueber die Abkühlung von Körpern mit inneren Wärmequellen.) H. SCHMIDT & W. UHINK. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 20, 1930, Report 165, pages 323–342; *Stahl und Eisen*, Vol. 51, Feb. 5, 1931, pages 176–177.

The article gives the practical results and the mathematical evaluation experiments on the cooling of bodies in which heat is generated during the cooling process (for instance, change of crystal form in iron alloys). GN(20)

Ford Production Methods. T. GORST. *Automobile Engineer*, Vol. 20, Nov. 1930, pages 442–444.

Abstract of a paper presented to the Institution of Production Engineers. Deals very briefly with metals used and their treatment. Considers largely handling and assembly methods, size of plants, payment of employees and a trade school for boys. RHP(20)

The Lateral Bending of Bars, Limited by Surfaces of Second Order. A. N. DINNIK & A. S. LOKSHIN. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Nov. 1930, pages 785–808.

Deals largely with the mathematical theory of forces required in bending lateral bars of varying cross-section. Considers the elliptical cylinder, elliptical cone, triaxial ellipsoid, hyperboloid of one and of two sheets, and the elliptical paraboloid. RHP(20)

The Removal of Beer-Stone from Brewery Apparatus of Aluminum. (Zur Frage der Entfernung des Biersteins aus Aluminium-Brauereigefässen.) G. ECKERT. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Nov. 1930, pages 194–196.

After a short storage time, a precipitation or deposit, beer-stone, is formed on the walls of the tanks which must be removed from time to time to prevent an impairment in the quality of the beer. Several means for the removal have been tested. Nitrous gases were found to be the most effective. The method of their application is described. Ha(20)

LABORATORY APPARATUS (21)

An Automatic Apparatus for Making Corrosion Determinations. G. KUERNER. *Chemist-Analyst*, Vol. 19, May 1930, page 18.

The corrosive liquid is heated in a beaker and percolated through a glass onto the sample supported in a glass tube above the beaker. A reflux condenser attached to the tube returns the liquid to the beaker and the action is continuous. The apparatus can be assembled from materials carried in any laboratory. CEM(21)

An Oxy-Aluminum Blowtorch. R. A. BAKER & F. M. STRONG. *Industrial & Engineering Chemistry*, Vol. 22, July 1930, pages 788–789.

A blowtorch utilizing finely powdered Al as fuel is described. The combustion products show less than 2% unburnt Al. Molybdenum melts in this flame, tungsten (1 mm.) does not. The Mo melt, when analyzed, showed no Al. MEH(21)

Laboratory Feeder for Flotation Reagents. *Engineering & Mining Journal*, Vol. 131, Mar. 23, 1931, page 277.

An illustrated description of an apparatus affording close regulation of minute quantities on a laboratory scale. Addition of oil is made by an eccentric revolving disc dipping into a storage tank. The amounts of reagents fed may be regulated by changing the volume of the cups and the number of cups used on each disc and by varying the tipping angle when discharging the contents of the cups. WHB(21)

Laboratory Tester of Lubricants Available for the Shops. *Electric Railway Journal*, Vol. 75, Mar. 1931, page 154.

The Timken Roller Bearing Co. has just put out a testing apparatus to determine the quality and efficiency of lubricant and bearing metals under various conditions of load. The apparatus consists of a cast iron base which supports the testing mandrels, two levers and a container holding a gallon of the lubricant on test. The tank is mounted above an electric heater which can heat the oil to the temperature of 210° F. The oil flows over the test piece to a sump and its rate of flow is adjusted by a valve in the line. From the sump the oil is pumped back to the tank in the base driven from the testing mandrel. Driven by a variable-speed motor the mandrel is rigidly held in alignment by two Timken bearings and is tapered at the test end to receive the tapered cup of a bearing. This cup forms one of the test pieces and is held in place firmly by a nut on the threaded end of the mandrel. Two levers, one above the other, form the heart of the apparatus—the upper is the load lever and the lower the friction lever. The upper lever carries the test block and is pivoted on a knife edge in the lower lever, which is also pivoted on a knife edge and has a stop at the unloaded end. The test block is parallel to the revolving cup, and the unit loading over the length of both pieces is constant. A small piece of metal ½ × ½ × ¾ in. hardened to Rockwell C-60 and ground, forms the test block. It is inserted in a notch in the load lever and is held in place by a wedge. For testing bearing metal, both the test block and the cup can be made of appropriate material. The friction lever has a vernier scale and a sliding weight scale for accurate measurements. Both levers are equipped with hangers for adjustable weights. The operation is outlined. A chart is furnished with the apparatus to indicate the necessary weights per 1000 lbs. pressure. WHB(21)

FOUNDRY PRACTICE & APPLIANCES (22)

Sand Control Increases Economy in the Foundry. O. E. J. ABRAHAMSON. *Foundry*, Vol. 58, Mar. 15, 1930, pages 84–87; April 15, 1930, pages 74–78; May 15, 1930, pages 56–60; June 15, 1930, pages 56–59.

Describes the results of study of the various components of molding sand by analysis and synthesis. Gives curves showing the relationship between % of bond, size of sand grain and the permeability determined according to the American Foundrymens' Association method. Further tests conducted with synthetic sands containing lake sand of 94.83% SiO_2, 2.78% Fe, and Al oxides, 1.02% lime and 0.96% magnesia. Tabulates results. By the use of the permeability device, the hardness tester and electrical moisture testing device, molding sands are quickly tested for openness, permeability, bond and moisture. Sand may show a high dry bond strength, considerable trouble may arise from its use in the form of dirt, washes, scabs, drops, etc., since the true bond may be low. Addition of fine grades of sand to coarser grade reduces the permeability of the mixture. The maximum permeability of a sand is higher than the average permeability in almost direct proportion to % of bond present. The study of molding sands has resulted in establishment of laws and rules making it possible to take any number of sands and by simple calculations to predict the properties that any mixture of these sands will have. Author describes his own laboratory tests of sand control in foundries. VSP(22)

Melting Furnaces for Use in the Bronze Foundry. ERNEST R. DARBY (Federal-Mogul Corp.). *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1247–1250.

Defective bronze castings may often be due to improper melting or to a furnace not suited to the material it is to melt. A furnace with a fixed neutral atmosphere is the most suitable for castings made of virgin metals. An excellent example is the induction electric furnace. The coke-fired pit furnace with its reducing atmosphere, and the oil- and gas-fired crucible furnaces, with their adjustable atmospheres, are applicable to melting this class of material. The latter are also suitable for melting other classes. The large capacity oil- or gas-fired reverberatory furnace is not well suited for melting virgin metal compositions, unless there is sufficient tonnage of one class of alloy to permit of keeping a furnace specially for it. Secondary bronzes with much more than 5% Zn are satisfactorily melted in any of the crucible or electric furnaces, the arc furnace being exceptionally good. The open-flame reverberatory and cupola type furnaces are of most service for low Zn bronzes. MS(22)

Select Brass Scrap with Care. J. W. ARTHUR. *Foundry*, Vol. 58, Sept. 15, 1930, pages 72–73.

The composition of the scrap decides the amount to be used. When fine castings are desired sheet scrap should be used, but the composition must be known. When salt has been used as flux the resulting sheet when made up into manufactured goods is liable to failure. In melting, Cu should be charged first, then the scrap and the Zn last of all. VSP(22)

Lamp Post Design Determines Molding Methods. NORMAN F. HINDLE. *Foundry*, Vol. 58, Dec. 1, 1930, pages 82–84.

Describes method used by the Westinghouse Electric & Manufacturing Co. Two methods are used in the manufacture of gray iron lamp posts. Those which are fluted are rammed by hand while those with shallow or no flutes are made on a jolt, roll-over, pattern draw molding machine. Iron used in the posts is a 10% steel mixture. Pouring temperature depends upon the size of the casting. VSP(22)

Steel Foundrymen Should Study Pattern Costs. WILLIAM DONNELLY. *Foundry*, Vol. 58, Aug. 15, 1930, pages 56–57.

Abstract of paper presented before the Small Castings Division of the Steel Founders' Society of America at Chicago. VSP(22)

Sound Malleable Iron Castings Depend on Feeding Methods. EDWIN BREMER. *Foundry*, Vol. 58, Oct. 1, 1930, pages 76–80.

Describes method employed in producing castings at the Maumee Malleable Castings Co., Toledo, Ohio. VSP(22)

Southern Foundry Concentrates on Special Pipe Shapes. PAT DWYER. *Foundry*, Vol. 58, Oct. 15, 1930, pages 54–58.

Describes method used by the Bessemer Foundry & Machine Co., Bessemer, Ala., in the production of miscellaneous castings of odd and intricate shapes. VSP(22)

Pressure Die-Cast Aluminium Alloy Test-Pieces. J. D. GROGAN. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 279–304.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 855. (22)

Die Casting or Mold Casting. (Spritzguss oder Kokillenguss.) A. KAUFMANN. *AEG-Mitteilungen*, Vol. 4, Mar. 1931, pages 176–180.

The decision whether a metal piece is to be cast in a mold or in a die must be made by the designer, since the shape must utilize the respective advantages of the methods. For a very exact casting, the die gives best results. A table shows the limitations for die casting both for low melting heavy alloys and for high melting light alloys. For certain requirements with respect to mechanical properties, mold casting is preferable since the velocity of cooling influences these properties very materially. Ha(22)

Synthetic Molding Sand Requires a Proper Base. L. B. KNIGHT (Illinois Clay Products Co.). *Foundry*, Vol. 58, Dec. 1, 1930, pages 80–81.

Abstract of a paper read before the Wisconsin Gray Iron Foundry group. Chemical analyses of good fire clay vary from 50 to 65% silica; 30 to 42% alumina; and 3 to 4% bond. Few clays contain more than 4% Fe. Moisture loss on ignition varies from 8 to 16%. Fusion point of good plastic fire clay is about 3000° F. It is not difficult to manufacture a synthetic molding sand. Moisture content is one important item to be considered in use of synthetic sand. Proper moisture is between 4½ to 5½%. VSP(22)

Strong Aluminum Castings Are Obtained by Improved Foundry Practice. T. D. STAY, E. M. GINGERICH & H. J. ROWE. *Foundry*, Vol. 58, Dec. 1, 1930, pages 72–75, 103.

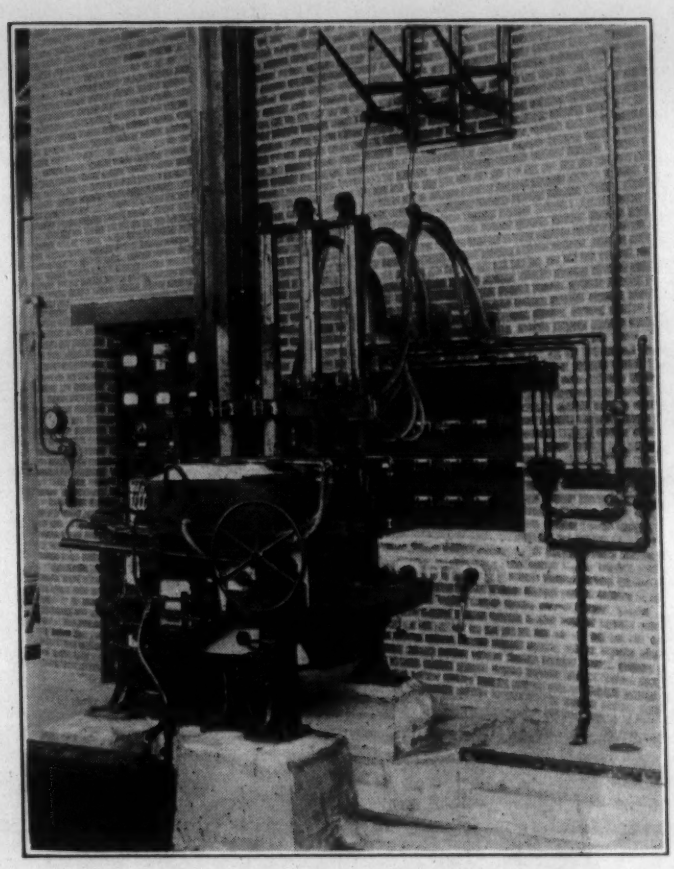
From a paper presented at the annual meeting of the American Foundrymens' Association in Cleveland, May 12–16, 1930. Methods of molding castings from same pattern may vary, and no two castings will show same properties. Since castings must withstand certain stresses, probably only one of the methods of molding will fulfill requirements. VSP(22)

Light Alloy Pistons Are Cast in Permanent Molds. EDMUND R. THEWS. *Foundry*, Vol. 58, Nov. 15, 1930, pages 67–69.

Light piston alloys should possess sufficient strength to withstand the shocks and gas pressures imposed at temperature varying from 200° to 400° C. Thermal absorption capacity and conductivity must be high. Addition of Ni and Mg appears to lower the specific weight. Gives a list of some satisfactory light piston alloys produced in America, England, Germany and France. Another table gives the physical and mechanical properties of some European alloys. All piston alloys contain from 3 to 15% Cu. A series of new Al alloys containing in addition to Cu, varying amounts of the Fe group. These alloys have a low coefficient of expansion. Thermal conductivity of light Al alloys is high. Chief advantages of higher thermal conductivity Al alloys claimed are: Increase in power, fuel economy and elimination of carbonization of oil under piston head. Permanent molds are used for casting all but the complicated types of pistons. Sal-ammoniac coagulates drosses; it is added to the melt just before casting. Alloys are usually melted in graphite crucibles. VSP(22)

MOORE RAPID 'LECTROMELT FURNACES

Lectromelt



A 500 lb. per hour 'LECTROMELT furnace installation being used for special alloy work.

'LECTROMELT furnaces offer the rapid and economic means of producing stronger, denser, cleaner and closer grained irons and steels under constant analytical and temperature control.

Over 40 users making corrosion and heat resistant irons and steels.

WRITE FOR PARTICULARS

Pittsburgh Electric Furnace Corporation
Pittsburgh, Penna.

Cupola Pitfalls and Ways to Avoid Them. ROBERT W. WATSON (Semet-Solvay Co.). *Foundry*, Vol. 58, Dec. 1, 1930, pages 85–86.
From a paper read before the American Foundrymens' Association. Long life of lining is essential for economic success. Successful melting depends on the lighting, burning of the bed, measurement of air, pressure of air and accurate weights and measures. Many important variables have a direct bearing on the successful operation of the cupola in the foundry. VSP(22)

Cast Pipe with Universal Joints. PAT DWYER. *Foundry*, Vol. 58, Nov. 15, 1930, pages 42–46.
Describes method employed by the Central Foundry Co., Bessemer, Ala. VSP(22)

The Preparation and Laboratory Control of Foundry Sands. J. D. BURLIE. *Journal Western Society of Engineers*, Vol. 36, Apr. 1931, pages 80–89.
A paper which won the Charles Ellet Award of the Junior Engineers in 1930. An outline is given of the general characteristics, source, preparation, requirements and methods of control of foundry sands. Sands have two main classifications: those containing little or no natural binding material and those containing it. The first group is used essentially in the production of synthetic molding sands and cores and the latter as a molding sand. Sand testing and control equipment are discussed and many data tabulated. Conclusions drawn are: Introduction of controlled properties of molding sand has contributed to the realization of a more positive control of casting technique. By the use of suitable sands, the scrap losses may be reduced and result in an improved quality of castings. Accurately controlled sand properties bear a close relation to an increased rate of production. WHB(22)

Pressure Pipe is Cast Horizontally. PAT DWYER. Part I. *Foundry*, Vol. 58, Sept. 15, 1930, pages 48–51, 74; Part II. Oct. 1, 1930, pages 99–102.
Describes process of casting patented by J. R. McWane and used by the McWane Cast Iron Pipe Co. Pipes 16 ft. and up, 12 in. in diameter are cast in green sand molds and cores. Part II. Gives details of core making, shaking out and cleaning of long pressure pipe cast in green sand molds. VSP(22)

Continuous Oven Reduces Core Losses. J. B. NEALEY. *Foundry*, Vol. 58, Aug. 15, 1930, pages 58–60.
Describes a counter flow, heat sealed, indirect heated, gas fired, two compartment, continuous type, core oven to bake crankcase cores installed by the Studebaker Corp., South Bend, Ind. VSP(22)

New Foundry Casts Alloy Steels. EDWIN BREMER. *Foundry*, Vol. 58, Sept. 15, 1930, pages 61–63; Extended abstract, *Steel*, Vol. 87, Sept. 25, 1930, pages 54–55.
Describes new plant of Ohio Steel Foundry Co., Springfield, Ohio, in which only alloy steel castings are produced. The alloy steel castings consist of steels containing varying amounts of Cr and Ni. One of the alloys contains 35% Ni and 15% Cr and is used for heat resisting to withstand temperatures up to 2000° F. Another alloy contains 18% Cr and 8% Ni and will resist up to 1700° F. The third alloy contains 20% Cr and 2% Ni and will resist atmospheres containing sulphurous vapors. VSP(22)

Manganese Steel Manufacture Involves Care in Melting. G. P. MESSENGER (Kensington Steel Co.). *Steel*, Vol. 87, Sept. 25, 1930, pages 47–48, 50, 52.
Describes manufacture of Hadfield Mn steel. Outlines various processes of steel making. Mn steel is usually made by the cold scrap process in the basic electric furnace. Scrap must have a very low P content. During melting down, slag should be heavy in CaO and yet be fluid. When the bath is melted, a deoxidizing slag composed of 6 parts CaO, 1–2 parts powdered coke and 1 part fluor-spar is used. Bath should be exceedingly hot before the heat is tapped. Cores should be removed as soon as the steel is solidified and strong enough to withstand handling. Castings with uneven sections are charged immediately into a hot furnace and allowed to remain until the heat has been distributed uniformly through the mass. Shrinks or checks are usually eliminated by welding. In annealing, rate of heating should be comparatively slow especially during the latter part of the heating operation, and the casting should be protected from oxidation. The castings are cooled by dumping into H_2O as cold as it is possible to obtain. MS(22)

Preventing Unsoundness in Bronzes and Red Brass. *Foundry*, Vol. 58, Sept. 1, 1930, pages 108–111; Oct. 15, 1930, pages 75–78; Nov. 15, 1930, pages 47–50, 54; Dec. 15, 1930, pages 48–51, 76.
Of the 3 conditions of atmosphere, the most difficult to obtain is the neutral one. Most bronzes absorb gas formed by incomplete combustion. The amount of solution increases rapidly with increase in temperature, the duration of overheating and increase in explosion pressure of incoming fuel. Most harmful effect of gas is due to its precipitation at or near the temperature of solidification. With reducing atmosphere there is a danger of gas absorption during the first period. In melting in oxidizing atmosphere, the most serious difficulty is the formation of oxides. The solubility of hydrogen and carbon monoxide and sulphur dioxide is reduced by alloying with tin and zinc. It is reduced still further by the presence of oxygen in metal. The critical period during the production of sound bronze and red brass castings is the solidification period. During freezing, bronze contracts considerably. Cooling rate depends on pouring temperature of alloy, relation of volume to surface area, the use of chills and like factors. In addition to unsoundness caused by gas, certain elements in bronzes and red brass have a considerable effect upon the properties of the alloys. Elements having a deleterious effect include Al, Sb, As, Bi and Fe. Ni appears to have a beneficial effect, while Si causes incipient shrinkage. Gives data obtained from various investigators under same melting conditions. S forms sulphides and inclusions in the metal. By using soda ash fluxes, S may be reduced. Much of the difficulty encountered from porosity in non-ferrous alloys may be due to the type of atmosphere maintained in the furnace. Woyski and Boeck conclude that gas and shrinkage cause porous metal and intercrystalline fissures. Metal subjected to bad melting practice may be brought back to normal by proper furnace practice. According to Bolton and Weigand in advancing the incipient shrinkage theory, the observations of Woyski and Boeck and the indicative effects of atmospheric conditions in open flame gas, crucible and indirect arc electric furnaces are confirmed. Inclusions appear as patches. Blow-holes are caused directly by the evolution of dissolved gas during solidification and, in case of Cu or its alloys, this gas is considered to be O. Best casting temperature for admiralty bronze is about 2192° F. Analysis of gas obtained by heating pure Cu resembles gas from Cu-Zn alloy and this suggests the gases causing unsoundness in alloys are actually in Cu itself. Bad influence of gas can be eliminated wholly or in part by thermo-mechanical treatment. Most of the work on unsoundness of bronze and red brass has resulted in modifying the effects rather than ascertaining the causes. In his recent work Daniels has attempted to solve the problem in 2 ways: (1) by applying existing knowledge to melting and casting of the alloy and (2) by examining the effect of various gases on small quantities of the alloy melted in small C or clay boats. N and CO_2 are neutral toward bronze. H is capable of causing unsoundness in bronze at certain rate of solidification. Improvement in density of sand casting can be obtained by melting in a pot-furnace with a thin fuel bed and good draught. Liquid shrinkage must be compensated by proper feeding. The object of gating is to fill mold perfectly and to supply fluid liquid metal to feed the casting and compensate for liquid shrinkage. Cope shrinkage usually is a consequence of cold metal and poverty of pressure. Effects of incipient shrinkage usually occur in section of casting last to solidify and between primary dendrites. Good raw materials are essential. Impurities to be avoided are: Si, Sb, As, S, etc. VSP(22)

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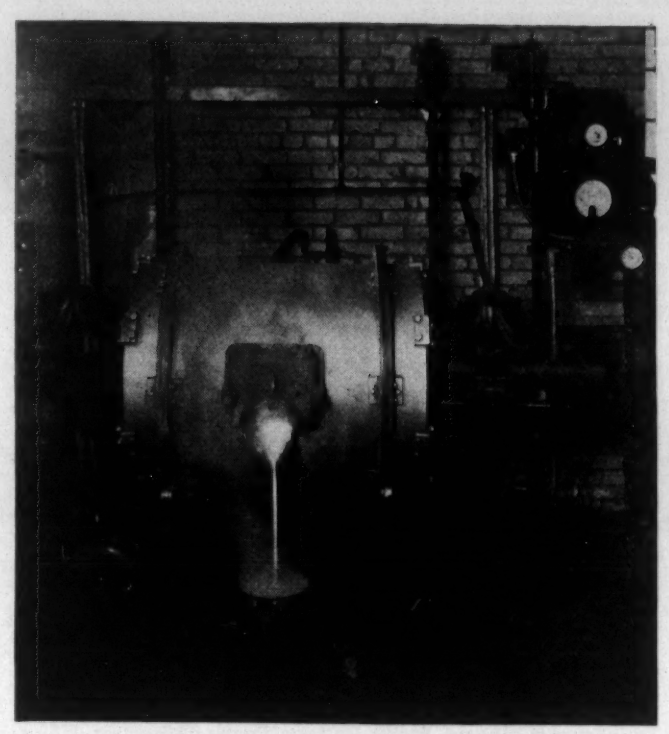

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FURNACES & FUELS (23)

Open Hearth Control. MARTIN J. CONWAY (Lukens Steel Co.). *Iron & Steel Engineer*, Vol. 8, Jan. 1931, page 29; June 1931, pages 289–298.
The author gives and discusses data compiled on a number of open-hearth furnaces. Discusses the various advances made since about 1922 in control of fuel-air ratio, checker temperature control, stack draft control. Fuels are discussed with the energy requirements of the open hearth. Waste gas movement and savings available by the application of proper control are discussed.

Coke-Oven Gases as Basis for Chemical Raw Materials. (Die Koksofengase als chemische Rohstoffbasis.) HORTS BRUECKNER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Jan. 24, 1931, pages 93–97.
The chemical utilization of coke-oven gases by the individual constituents, hydrogen, ethylene, carbon monoxide and methane must be carried out from the national economical viewpoint. Hydrogen is now utilized for synthetic ammonia in several plants and the quantities of methane produced by it can be converted into benzol hydrocarbons and chlorated dissolving agents; carbon monoxide and hydrogen can be converted into methanol and benzene hydrocarbons; ethylene is convertible into dissolving agents and ethyl alcohol. Processes for such conversions have been developed and promise to be commercially profitable if carried out on a large scale, if the price of coke oven gas does not exceed RM 0.015 to 0.017. These processes are discussed and practical figures are given. 14 references. Ha(23)

Continuous Reheating Furnaces for Rolling Mills. A. L. CULBERTSON. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, 1930; *Iron & Steel*, pages 61–72.
Includes discussion. Paper is confined to those furnaces used for reheating purposes, necessary for serving, rolling and piercing mills. Even this reduced field leaves it an extremely broad one when considering the types of furnaces required for the different operations. (23)

The Practical Side of Metallurgical Heat Application. H. DOBRIN. *Iron & Steel Engineer*, Vol. 8, June 1931, pages 256–264.
The author shows the great difference in the heating efficiencies obtained in boilers and metallurgical furnaces, 80% in the former against only about 20% in the latter. He points out that the boiler people have cut their stack gas temperature to 600° F. while metallurgical furnaces give off gas at 1600–1700° F. Metallurgical heating is hampered in obtaining maximum fuel efficiency on account of desire for quality in the product and by personnel. Failure to appreciate the advantages to be obtained and proper use of the equipment and methods available have resulted in inefficiency. Improvements that are being made particularly in the open-hearth and soaking pit furnaces toward control of the fuel-air ratio are pointed out. WLC(23)

High Frequency Electric Steel Furnaces. (Les fours à acier à haute frequence.) D. F. CAMPBELL. *Journal du Four Electrique*, Vol. 40, Apr. 1931, pages 125–134.
A paper presented at Sept. 1930 meeting of the Iron & Steel Institute in Czechoslovakia and printed, with discussion, in the *Journal of the Iron & Steel Institute*. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 16. JDG(23)

The Practical Side of Metallurgical Heat Application. H. DOBRIN. *Iron & Steel Engineer*, Vol. 8, June 1931, pages 256–264.
A paper pointing out the necessity of application to the details of control. Soaking pits are becoming standard equipment. For all proper metallurgical heating, the furnace pressure must be positive. Through the various heating processes, required to manufacture, say a seamless tube, quite a variety of furnaces are employed. Any one of these in a chain may undo the good of all the rest. Burners must be kept clean and other equipment must be inspected and cleaned. W.H.B.(23)

Germans Study Induction Furnaces. Correspondence from E. W. EHN, Cannstatt, Germany. *Metal Progress*, Vol. 19, Jan. 1931, pages 86–87.
Germans are giving this type of furnace considerable attention and are developing its metallurgical uses rapidly. WLC(23)

Electric Heating Insures Quality Production. H. J. FISCHBECK. *Electrical World*, Vol. 97, Apr. 11, 1931, pages 680–681.
Electric heat employed by the Pratt & Whitney Aircraft Corp. as a result of the following advantages: (1) high efficiency, with attendant quality of work, (2) simplicity of application, (3) close automatic temperature control, (4) cleanliness and improvement of working conditions, (5) impossibility of over heating any part of the charge, and (6) elimination of the combustion method with its attendant uncertainty of results and general fuel problems, plus reduced fire hazards. Carburizing, hardening and miscellaneous heat treating are handled. WHB(23)

Large Output of Steel from Cold Charge. Correspondence from F. GIOLITTI, Turin, Italy. *Metal Progress*, Vol. 19, Mar. 1931, pages 86–87.
The writer describes a new design of open-hearth furnace for greater fuel economy in production of steel from cold charge. WLC(23)

Hot-Blast Stove Heating and Its Equipment. HERMANN ILLIES. *Iron Age*, Vol. 126, Dec. 4, 1930, page 1699.
Describes the Askania high efficiency burner made by Zimmermann & Tansen, G.m.b.H., Düren Germany. This burner takes care of insufficient stack draft in supplying the necessary quantity of gas and air, and provides good combustion. For small capacities, burner can be fitted with injectors. VSP(23)

Large Industrial Furnaces with Gas Firing and Their Burners. (Gross-Industrieöfen mit Gasfeuerung und deren Brenner.) JOH. JEHNIGEN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 9, 1931, pages 577–583.
Low-pressure and high-pressure gas burners are described briefly and illustrated. The following types of furnaces are described and several constructions are illustrated: a small pusher furnace for heating steel bars, 5 t./hr., consumption about 500,000 to 540,000 kcal./t. of material; a large pusher furnace, for 45 t./hr., 385,000 to 425,000 kcal./t.; continuous and annealing furnaces, gas consumption 260,000 to 490,000 kcal./t. of wire; a furnace with moving hearth and moving material, for high grade sheets for deep drawing, about 550,000 to 600,000 kcal./t. are consumed. Ha(23)

Nitriding Furnaces and Equipment. W. J. MERTEN. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 502–522.
Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The author describes nitriding equipment used for continuous nitriding employing a movable bell electrical heater. The efficiencies of the equipment are given and discussed. The results are uniform and economically obtained. WLC(23)

Electric Heat-Treating Furnaces. A. H. VAUGHAN (Electric Furnace Co.). *Iron Age*, Vol. 125, Jan. 30, 1930, pages 357–361.
From an address before the Cleveland chapter of the American Society for Steel Treating. Describes the various types of electric furnaces. The advantages of the continuous electric furnace over other types is that every zone does the same part of the heating and can always operate close to 100% of capacity. For annealing work the counterflow recuperative type of furnace gives good results. Power consumption is about half that of a non-recuperative unit of the same size. Conveyor furnaces are difficult to construct. For heat treatment of Al alloys only electric heat is used. Largest furnace built is a 3000 kw. car type. VSP(23)

Car Bottom Furnace Used in Jobbing Heat Treating Plant. *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1237–1238.
Wesley Steel Treating Co., Milwaukee, has added a gas-fired, single-end, car-bottom furnace for miscellaneous heat treating, annealing, hardening and carburizing. It is 13 ft. long, 6½ ft. wide and 5½ ft. from car top to spring line of arch. There are 11 two-stage velocity type burners on each side, so staggered as to provide both over and under firing. MS(23)

Heat Treatment Furnaces Used in the Manufacture of Telephone Equipment. W. A. TIMM. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1395–1398, 1417.
From paper read before the American Society for Steel Treating. MS(23)

Electric Annealing of Aluminum. *Metal Industry*, London, Vol. 38, Apr. 3, 1931, page 364.
Description of a new single track multi-car type electric annealing furnace, rating 150 kw. at 440 volts with nickel-chromium heating elements on side walls, roof and each section of car. Running contacts below the car are used. The furnace is 24 ft. × 7 ft. 5 in. and is used for annealing Al sheet. PRK(23)

Brass Melting Furnaces Are Fired with Two Oil Burners. CHARLES VICKERS. *Foundry*, Vol. 58, Nov. 1, 1930, page 92.
Describes an oil-fired rotary, non-crucible furnace for melting Ni-Ag alloys, bronze, brass and Al. Furnace was devised by Tasman Storey, Storey Bros., Ltd., Sydney, New South Wales. VSP(23)

Open-Hearth Furnace Developments in 1930. *Iron Age*, Vol. 127, Jan. 1, 1931, page 35.
Attention to combustion of fuels and automatic control of furnace operations has marked the progress in open-hearth practice the past year. No startling developments made during the year, merely a progression along lines already well explored. VSP(23)

Electric Furnaces for Melting Aluminium. *Metal Industry*, London, Vol. 38, Apr. 3, 1931, pages 357–360.
Translated by I. Boodson from "Das Electrische Schmelzen von Aluminium" by Russ in *Zeitschrift für Metallkunde*. There are given descriptions of electric crucible furnaces of 50–350 kilos capacity, tank furnaces with refractory brickwork for unwieldy charges and hearth furnaces for large charges and high output. PRK(23)

Experiments on the Heat Transfer in Rolling Mill Furnaces with Special Reference to the Soaking of the Ingots. (Versuche über den Wärmeübergang in Walzwerksöfen unter Berücksichtigung der Durchwärmung der Blöcke.) A. SCHACK. *Archiv für Eisenhüttenwesen*, Vol. 4, Jan. 1931, pages 333–342; *Stahl und Eisen*, Vol. 51, Feb. 5, 1931, pages 162–164.
Report 146 of the Heat Committee of the Verein deutscher Eisenhüttenleute. The heat transfer in industrial furnaces was studied, particularly in rolling mill furnaces. The results of the measurements and the practical conclusions are discussed. Considerable temperature differences were found between the top surface and the bottom surface of the heated material. Temperature differences of 200° C. were observed even in small billets of 90 mm. in the middle of the furnace. In 210 mm. billets, differences up to 300° C. were found. The practical conclusions are as follows: the temperature difference between top and bottom surface of thick material can be made equal to that of thin material when the heat transfer/unit time on the thick material is decreased proportionally to the thickness and by simultaneously increasing the heating time proportionally to the second power of the thickness of the material. This condition cannot be entirely fulfilled in heating furnaces. The heat transfer through direct radiation of the heating gases amounts to about 50% of the total transfer, 30% of the heat is transferred through radiation of the furnace roof, and a relatively small amount through convection. For the total heat transfer through radiation of gases and the roof and through convection, the following equation was found: α (total) = $50 + 0.45(t - 700)$ kg.cal./m.² hr.° C. GN(23)

The Theory of Coreless Induction Furnaces. (Zur Theorie der kernlosen Induktionsöfen.) W. ESMARCH. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 172–196.
A theory of coreless induction furnaces is developed under consideration of the finite length of coil and charge. All characteristic quantities can be calculated by means of 2 functions, A and Q, for which curves and tables are computed. The quantities calculated by the theory are about 2% exact. The efficiency of a high frequency furnace is independent of the frequency and depends only on the geometrical conditions of the furnace and the specific constants of the material (specific resistance and permeability) as long as the condition (always fulfilled in melting furnaces) holds good that the ohmic resistance of the charge is small against the inductive reactance of the latter. If this condition is not fulfilled, the efficiency decreases with decreasing frequency. The energy consumed by the charge can be represented over the whole range of $d = 4\,\delta$ by

$$W_2 = 6.1 \times 10^{-10}\, QA\sqrt{\sigma\mu\nu}\, z^2 \text{ KW}$$

with an error not over 3%; in this case, z = number of ampere turns, d = diameter of charge, δ = penetration depth of the current. A formula is developed for the motive forces which determine the motions in the bath and the crown of the level of the bath, and another formula which permits the calculation, for a given frequency, of the smallest diameter of the furnace for economical operation. The theory was confirmed by a series of experiments. Ha(23)

Use of Fuel Oil in Steel Making Offers a Path to Increased Economies. MARTIN J. CONWAY (Lukens Steel Co.). *Iron Age*, Vol. 126, Aug. 21, 1930, pages 486–487, 517.
Calorific efficiency of open-hearth furnaces has not improved. For every 100 lbs. of fuel burned, only about 30 lbs. are utilized in actual manufacture of steel. Production of steel with lowest expenditure of fuel depends on: (1) Quality of fuel; (2) Furnace output; and (3) Efficient utilization. For commercial heat production the combustible elements must have an affinity for O_2. Fuel oil is especially rich in combustible elements. Advantages of fuel oil are: it does not lose its fuel value in storage; it burns with a high flame temperature, but it is not hard on refractories; checker remains clean longer; and stack capacity is reduced 35%, when compared with producer gas. Oil should be properly atomized. Each checker chamber should be uniformly heated. Gives a list of 33 usual causes of waste. VSP(23)

Wire Patenting Furnace Proves Very Economical in Operation. R. E. BARKER. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1409–1410.
Describes gas-fired furnace, constructed on recuperative setting, which gives very satisfactory operation on all sizes of rod or wire being run at varying speeds, with positive control of atmosphere and economy in fuel. MS(23)

Continuous Reheating Furnaces for Rolling Mills. A. L. CULBERTSON (Rust Engineering Co.). *Rolling Mill Journal*, Vol. 4, Oct. 1930, pages 527–530, 555–556.
From paper read before the American Society of Mechanical Engineers, Sept. 22–24, 1930. MS(23)

Application of Metallic Recuperators to Industrial Furnaces. G. D. MANTLE (Surface Combustion Co.). *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1389–1390.
Abstract of paper read before the Iron and Steel Division of the American Society of Mechanical Engineers. MS(23)

REFRACTORIES & FURNACE MATERIALS (24)

Refractory-maintenance Cements in the Nonferrous Foundry. H. E. WHITE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Nov. 1930, pages 654–672.

Forty-nine brands of cements were studied. Data secured in 1926 and 1929 are compared and show that the use of the so-called super-refractories are on the increase. CHL(24)

The Possibility of Andalusite as a Refractory. FRANK H. RIDDLE. *American Electrochemical Society, Preprint* 59-24, April 1931 meeting, 16 pages.

Important developments in the composition and method of manufacture of refractories have taken place during the last ten years. Length of service is today the preliminary consideration in the selection of a refractory. The commercial development of $Al_2O_3 \cdot SiO_2$ refractories is briefly outlined. The outstanding results stimulated the search for extensive deposits of a natural mineral of this so-called "sillimanite type." Regardless of the proportions in which the two oxides Al_2O_3 and SiO_2 occur to begin with, after exposure to furnace temperatures mullite, $3Al_2O_3 \cdot SiO_2$ is formed with one or the other oxide in excess. Many experiments have shown that andalusite of proper grain size and proportion, when held together with a minimum amount of a plastic aluminous bond such as clay, makes a very desirable active refractory. It is constant in volume during the calcining. An extensive deposit of andalusite has been located in Mono County, California. About 350 million spark plug cores have been made from this andalusite. Important localities of cyanite, sillimanite and dumortierite are briefly described. Tests on andalusite refractory are detailed, demonstrating its superiority over other refractories of this class. (24)

Refractory Materials for Electric Furnaces. II—Copper and Its Alloys, Including Bronze, Gun-metal, Brass, Copper-Nickel and Phosphor-Bronze. ALFRED B. SEARLE. *Metal Industry*, London, Vol. 38, Mar. 27, 1931, pages 333–335.

Magnesite brick linings should be used in furnaces for smelting, refining or melting Cu and its alloys if Pb is present. The use of silica, fireclay, fused magnesia, magnesia spinel, Kieselguhr, carborundum and zirconia is discussed along with fritted linings which give satisfactory service with high copper brasses. PRK + WHB(24)

Refractories. Report of A. S. T. M. Committee C8. G. A. BOLE, Chairman. *Preprint No. 50 for June, 1931 Meeting American Society for Testing Materials.* 10 pages.

Slight changes are proposed in some specifications and methods of test sub-committees are developing abrasion tests for high and room temperatures, methods of making the pyrometric cone equivalent test, types of furnaces for high temperature load tests, and petrographic methods for study of slag attack upon refractories. The development of methods for measuring heat transmission is also mentioned. HWG(24)

Refractory Materials for the Induction Furnace. J. H. CHESTERS & W. J. REES (Sheffield University). *Iron & Steel Institute, Advance Copy* No. 4, 1931, 16 pages.

Crucibles can be used in the coreless induction furnace, but for production work it is best to use sintered linings. A flux is usually required in order to cause sintering. Boric acid is frequently used for this purpose. It is necessary to have properly graded materials, as powders containing particles of only one size do not bond well. Microscopic examination of used linings indicated that the slag frequently attacked the bonding material. Methods for testing linings are discussed. Contains 9 references. JLG(24)

Metallurgical Refractories. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, page 245.

An abstract from an article by J. F. Hyslop on the subject of "High-Alumina Firebricks," in which some discussion of the resistance of these refractories to temperature, to solution and disintegration by fluxes and dust-laden gases, and to rapid temperature changes is given. The relation of the cost of production of high-alumina refractories to alumina content is briefly described. OWE(24)

Special Refractories for Use at High Temperatures. WM. H. SWANGER & FRANK R. CALDWELL. *Bureau of Standards Journal of Research*, Vol. 6, June 1931, pages 1131–1143.

The choice of the most suitable refractory for the laboratory melting of pure metals at temperatures from 1700° up to 2200° C. without detrimental contamination of the metal by the refractory depends upon a number of factors, such as the stability of the refractory at the higher temperatures, the means available for forming and firing of crucibles, the type of melting furnace, chemical action of the particular metal in question, etc. Methods are described in detail for the preparation of crucibles and other shapes from the oxides of thorium, magnesium, zirconium and beryllium. Thorium oxide, with a melting point above 3000°, is the most refractory of the 4 oxides named. The method used for fusing this oxide is described. Crucibles made of fused thorium oxide have been used in the determinations of the melting points of platinum and rhodium. Crucibles of the commercial fused magnesium oxide are not satisfactory for work with metals of the highest purity, but crucibles prepared from the so-called "C. P." or reagent grade of powdered magnesium oxide have been used at temperatures up to 2000° C. without detrimental effect upon the metal melted. The commercial electrically fused or sintered zirconium oxide contains small amounts of silica. Crucibles of this material have been used at temperatures up to 2000° C., but unless the melting is done in air, there is danger of contamination of the metal by the silicon in the refractory. From a few experiments made with a small amount of the very pure oxide there are indications that, if available commercially, beryllium oxide might be a satisfactory refractory for use at high temperatures. WAT(24)

GASES IN METALS (25)

Oxygen in Steel. MARCUS A. GROSSMAN (Republic Research Corp.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 601–631; *Metal Progress*, Vol. 18, Nov. 1930, pages 33–37, 102–106.

Fifth Edward De Mille Campbell Memorial Lecture presented at the 12th Annual Convention of the Society, Chicago, Sept. 1930. Includes 19 references, is illustrated with 15 micrographs, 8 photographs of macrostructures, 5 tables of analytical data and 2 graphs. The author discusses methods of determining the oxygen in steel. The vacuum method is most satisfactory and determines the total oxygen. The occurrence of oxygen in various forms in steel is discussed. Several hundred analyses show the normal amount of oxygen present in steel to vary according to composition and method of making. Representative analyses show a range of .006–.060%. Oxygen in certain forms affects the behavior of carbon in steel, rate of hardening, decarburization and microstructure. Pack carburizing results in an increase in the oxygen content of steel. Steels where this ncrease is greatest show the separation of the pearlite characteristic of structural "abnormality." A very slow cooling rate, 5000 minutes will produce in normal steel the same separation produced in an abnormal one by cooling in 1 minute from the carburizing temperature. Carburizing in methane suppresses the gain in oxygen content and the structural abnormality. A steel which absorbed .071% oxygen in pack carburizing with almost complete separation of the pearlite showed an increase of .002% oxygen when carburized in methane and a perfectly normal pearlite. WLC(25)

Alloys of Iron and Oxygen. C. H. HERTY, JR. (U. S. Bureau of Mines). *Metal Progress*, Vol. 19, June 1931, pages 99–100.

8 references to the literature are cited. Discusses the constitutional diagram published in April issue by Mathewson and the effect of iron oxide on the properties of steel. WLC(25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Manganese-Free Zirconium-Treated Steels. FREDERICK BECKET. *Mining & Metallurgy*, Vol. 12, May 1931, pages 234–236.

Results of tests show interesting possibilities in the use of Zr. Read before Iron and Steel Div. of A. I. M. E. Gives results of investigation to determine whether normal plain C steels of widely varying C and S contents and some alloy steels could be successfully fabricated if substantially free from Mn, but treated with Zr, and secondly to determine the physical and other properties of these steels. VSP(27)

Effect of Lead on Brass and Bronze. H. P. CROFT (Chase Brass & Copper Co.). *Metal Progress*, Vol. 19, May 1931, pages 60–65.

Forging brass for free machining is held to 1.5 to 2.0% Pb. Lead does not impair the physical properties and improves the machinability within this range. In amounts over 2%, lead improves corrosion resistance of brass and bronze but with some impairment of physical properties due to intergranular weakness. For deep drawing and welding applications lead should be kept to a minimum. Graphic and tabulated data on the effect of lead on season cracking, bend test, tensile strength, elongation, and machinability are given. WLC(27)

The Action of Phosphorus and Oxygen in Copper-Tin Heats and Alloys. (Ueber das Verhalten von Phosphor und Sauerstoff in Cu-Sn-Schmelzen und- Legierungen.) RICHARD FALKENSTORFER. *Metallwirtschaft*, Vol. 10, Feb. 13, 1931, pages 130–131.

Contains 11 references. The alloy Cu 85, Sn 8, Zn 5, Pb 2, with P from 0 to .63, was cast under reducing conditions at 1080° in green sand molds into 1" diameter test bars. Both tensile strength and elongation increase slightly with rising P content up to .12%, then drop sharply and remain fairly constant with higher P. Microscopic specimens were annealed for 8 hours at 700° and furnace cooled. Up to .15 P the structure was completely homogeneous. From .21 P up the phosphide eutectic was present in increasing amounts. Up to .12 P the fracture was intracrystalline, with .15 P it was intercrystalline. The higher the P the more the mold sand burns on due to the reducing action of P. With P over .15 "blossom" formation takes place on the risers due to the low melting point of the phosphide eutectic. No P is volatilized holding the melt for 25 minutes at 1100° and the maximum Zn loss was .3%. If this alloy containing .1 P is exposed to the air intermittent oxidation and reduction by P takes place until all but a trace of P is removed from the melt. If a substance is present which has greater affinity for O than P, such as Al, a permanent oxide skin is formed over the metal in spite of the P. P will reduce a badly oxidized Cu-Sn alloy. The alloy containing 5% Zn will be free from SnO_2 due to reduction by the Zn, even if SnO_2 is added under oxidizing conditions. Oxidized bronze containing traces of SnO_2 had the same tensile strength and elongation, but lower corrosion resistance and endurance limit. CEM(27)

Influence of Small Quantities of Foreign Metals upon the Properties of Refined Zinc. (Einfluss geringer Mengen von Fremdmetallen auf die Eigenschaften von Raffinadezink.) O. BAUER & P. ZUNKER. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 37–46.

Includes discussion. The influence of small quantities of Cd, Cu, Zn, Fe, Sb, Mg and P upon the contraction (from the liquid state), impact strength, and Brinell hardness of "refined zinc" (Pb = 1.12%, Cd = 0.11%, Fe = 0.03%, Cu = 0.002%) was studied. The results were compared to those of "pure zinc" (Cd = 0.019%, Pb = 0.014, Cu = 0.001%). Reviews of published work on the constitution of the binary systems of the above named metals with Zn are given, and for each system new data are given for the contraction (linear) from the liquid state, impact strength and Brinell hardness, in each case from 0 to 3 weight % of the added metal. From the data it is concluded that Sn is the most suitable metal to be added to Zn intended for casting purposes. Sn diminishes the contraction of Zn very considerably while only slightly decreasing the impact strength with small additions of Sn and actually increasing it between 1 and 3%. The hardness remains little affected. Mg diminishes the contraction as strongly as Sn, but the impact strength diminishes greatly, while the hardness rises. Thus Zn castings with Mg are brittle and hard. Cd likewise diminishes the contraction. The effect is small at low concentrations of Cd, but approaches that of Sn and Mg at higher concentrations (2–3%). The impact strength and hardness are but little affected. Small quantities of Sb diminish the contraction greatly but larger amounts are proportionately less effective. Sb exerts but little influence upon the impact strength and the hardness. Cu affects the contraction very little, but the impact strength and hardness are both considerably increased. Pb is practically without effect upon the 3 properties studied. Fe in general is favorable. Its influence upon contraction is slight, but the impact strength is greatly decreased and the hardness increased. The casting is thus harder and more brittle without concomitant diminution of the shrinkage as with Mg. RFM + EF(27)

Malleable Iron Alloyed with Nickel and Chromium. (Nickel- und Chromlegierter Temperguss.) R. WENTRUP & W. STENGER. *Die Giesserei*, Vol. 18, Jan. 2, 1931, pages 24–28.

The influence of Ni (0.5–1.8%) and Cr (0.08–0.22%) on the cementite decomposition in the production of malleable cast Fe is investigated dilatometrically, the Fe samples being annealed at temperatures up to 940° C. for 10 hours. When present in amounts up to 1%, Ni has no great influence on the decomposition, but at 1.8% it promotes the decomposition considerably. Cr has an inhibiting effect on the decomposition even when present in small amounts, being practically prevented by 0.22% Cr. In a malleable Fe containing both Ni and Cr, the disadvantageous action of Cr is removed to a considerable degree by Ni. Microphotographs (6) of various stages of the carbide decomposition are given. (27)

INSTRUMENTS & CONTROLLERS (28)

Note on Copper Constantan Thermocouple Calibration Below 0° C. R. WIEBE & M. J. BREVOORT. *Bureau of Mines Report of Investigations* 3077, Mar. 1931, 7 pages.

The deviation curve in connection with Adams or Southard and Andrews data from 0° to −193° C. for copper constantan thermocouples calibrated at the normal sublimation point of CO_2 and the normal boiling point of oxygen can apparently be represented by a quadratic equation, Deviation = $ae-be^2$ with an accuracy of about 0.05° C. AHE(28)

Heat Conductivity Values of Plate-Shaped Bodies. (Wärmeleitzahlen-plattenförmunger Korper.) S. GELIUS. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 21, 1931, pages 369–370.

At first, the influence of the shape of plates used for measuring the heat conductivity was investigated. It is stated that square plates are better for plates of more than 30 mm. while round plates are more suitable for thinner plates, down to 3 mm. The agreement of both types was about 1.5%. The accuracy of measurements is well within the limits permitted in the rules for testing heat and cold insulation equipment. Ha(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Alloys for Use at High Temperatures. W. ROSENHAIN & C. H. M. JENKINS. *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1233–1234.

Abstract of paper read before Iron & Steel Institute. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. MS(29)

The Mechanical Properties of Metals at Elevated Temperatures. P. CHEVENARD (Soc. Anon. Commentry-Fourchambault et Decazeville). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 155–178, 17 figures, 14 references.

Phenomena that are properly neglected as minor in industrial use of alloys for ordinary purposes cannot be neglected in certain special uses. Internal friction of metals is usually neglected, but the logarithmic-decrement is never zero so there is no true limit of elasticity. The decrement increases with temperature. The modulus, the thermo elastic coefficient and the internal friction are extraordinarily sensitive to the past history of the metal. Alloying additions do not produce major changes in modulus, but have vast effect on the decrement. Alloys and especially annealed alloys are more nearly elastic solid than are pure metals, especially when cold worked. Isothermic viscosity tests on fine wire show that metals pass progressively from the type with solid friction to the viscous type. In some conditions metal which has flowed is less likely to flow, it is work hardened. Under others it is more likely to flow, has negative work-hardening. The rate of deformation increases in exponential fashion with increase of load or of temperature. Hence rate is best expressed by a logarithmic function. On a 3-dimensioned diagram the surface showing temperature load and the logarithm of flow rate, is a hyperbolic paraboloid. The load-temperature curves for a given rate are equilateral hyperbolas. These relations are a first approximation. Study of viscosity under constant load at increasing temperature, (heating 250° C. per hour with differential compensation for thermal expansion) gives information rapidly. Such curves are given for a series of Ni-Cr alloys. Alloying produces rigidity, but the first addition is more potent than following ones. A combination of several alloying conditions is therefore advantageous. Very good results are obtained with Ni-Cr-Mo steels for use at 500° C. For higher temperatures alloying unaffected by heat-treatment are indicated, especially high Ni alloys plus Cr, W, etc. All metallurgists know that the limit of rigidity for practical use is the stress which, at the end of a given time produces a given elongation with a rate of extension less than a given value. It remains for them to standardize on the duration, elongation and rate. It has been thought by some that if the elongation could be measured with a very sensitive extensometer the time could be reduced to a few hours. It is prudent to adopt, at least provisionally, a much longer duration of test, since metallographic changes may occur that take place slowly. HWG(29)

The Performances of Cast Carbon and Low Alloy Steels in High- and Low-Temperature Service. R. A. BULL (Electric Steel Founders' Research Group). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 260–298, 23 figures, 27 references.

Cast steel parts are applied to high temperature uses, especially in power plants and oil refineries. If made conservatively thick, carbon steel castings act well up to 750° F. Low Ni-Cr cast steels perform well up to 1000° F. Railroad service, tractors, trucks and aircraft may use steel castings at very low temperatures. All available low temperature data are tabulated. Quenched and drawn carbon steel has less low temperature brittleness than when normalized. Ni or Ni plus V as alloy greatly improves low-temperature impact resistance of cast steel.

In high temperature service, cast steel of 0.30–0.40% C, 2% Ni, 0.8% Cr shows results much superior to carbon steel. Hitherto unpublished data on carbon, manganese-carbon and Ni-Cr cast steel are given. Comparison of 0.35% C, 1.42% Mn; and 0.48% C., 1.24% Ni, 0.80% Cr cast steels in creep tests showed that at 25,000 lbs./in.^{2} and 850° F., 10,000 lbs./in.^{2} and 1000° F. the Mn-C steel crept less for 500 or 600 hours, but then the curves cross and after that the Ni Cr was superior. Data from the General Electric Co. indicate that of a 0.44% C, 0.65% Mn, 1.2% Ni, 0.5% Cr; a 0.33% C, 1% Mn, 0.25% V and a 0.33% C, 1% Mn, 0.30% Mo steel the Mn-Mo steel was superior, creep stress to give 1% flow in 100,000 hrs. being, NiCr, about 10,000; Mn-V, about 6000 and Mn-Mo, about 15,000 lbs./in.^{2} at 840° F. At 930° F. the Mn-Mo steel gave about 12,500 lbs./in.^{2} while the Mn-V was down to 2500. A Cr-W combination is alleged to work well but nothing but propaganda is available on it, engineering data being lacking. At and above the equi-cohesive temperature, about 1000° F., large grain size, as in cast steel, gives much better creep resistance than small grain size, as in wrought material. Discrepancies in creep test results and in different makers claims are commented on. Generally the least optimistic data are the more reliable. The desirability of accelerated test methods is brought out. Much pertinent comment is made on the necessity of proper design in steel castings for high temperature service, to avoid failure from defects due to casting difficulties arising from wrong design, and in order fully to utilize the inherent properties of the steel. Steel foundry technique is more vital in producing service castings than is the chemical composition. HWG(29)

Engineering Requirements and Trends for Metals in the Non-ferrous Roasting, Smelting and Refining Industry. R. E. BROWN (Electro Metallurgical Corporation). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 77–94.

Because of the prevalence of sulphide ores, non-ferrous smelting has a special high temperatures sulphur corrosion problem added to those of oxidation and structural strength. This leads to avoidance of Ni and the use of Cr alloys. For rabble arms and blades of roasting furnaces, cast alloys of about 0.80 C, 17 Cr, or 1.10 C, 23 Cr are used. Abrasion and oxidation resistance and resistance to S and As and their compounds at 1500° F. are required for copper sulphide concentrates. Hearths of similar properties able to support a live load of 50 lbs./ft.^{2} are being tried. Dwight Lloyd sintering machines operate at 800° to 1500° F., and are all steel. Prospects are good for extensive use of heat-resisting alloys. Steel bins and hoppers for hot calcines and steel or cast iron stirrers for them oxidize rapidly at 1200–1400° F. 18 Cr, 8 Ni or 24 Cr, 11 Ni work well, the Ni not being harmful. High Cr Mn alloys are promising. Reverberatories for solid fuel use Ni Cr cast iron or Cr white iron, grate bars; those using oil or gas have high Ni Cr or Cr alloys in the burners. Highest quality alloys are required as they get very hot. Slag skimmers of high C high Cr are promising. Alloy molds for casting copper anodes are suggested to replace cast iron. Scrap could be used in making grinding-mill balls. Metal retorts for zinc smelting are impractical, but oxidation-resistant alloys might be useful for condensers. Zinc melting pots of 2½ Ni, 1½ Cr with 0.90 combined C seem somewhat better than ordinary cast iron. Similar pots are good for Pb, with temperatures below 1400° F. Plates for Cottrell precipitators in fume recovery, with gases at 275° F. or below, are subject to corrosion. Pb or Al are used. Cast iron tubes used in distilling Au Hg amalgam do not last long; a close grained iron that is resistant to oxidation and to cracking is needed. HWG(29)

Heat Treatment and Effect of Heat on Metallic Bodies. BRADLEY STOUGHTON & ALLISON BUTTS. *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1217–1233.

Constitutes an addition to the new edition of authors' "Engineering Metallurgy." Deals with properties of metals at different temperatures, grain growth and recrystallization, heat treatment for the purpose of hardening steel, annealing of steel, chilling cast-iron for hardness and heat treating steel and non-ferrous alloys for strength. MS(29)

Working Stresses for Steel at High Temperatures. Paper No. FSP-52-35. D. S. JACOBUS. *Transactions American Society Mechanical Engineers.* Vol. 52, Sept.-Dec., 1930, pages 295–304.

Some published results for stress to produce creep at higher temperatures have led to apprehension, which it is the object of the paper to dispel for the particular stresses which are discussed. The results secured in practical experience are used for setting the maximum working stresses for drums and superheater headers up to temperatures of 800° F., and for temperatures above 800° F., the working stresses are scaled down in proportion to the falling off of the stresses that produce creep. The first curve of creep stresses published by H. J. French of the Bureau of Standards was used, and the working stresses for a given temperature are taken at ⅔ the creep stress. The effect on the stress of piercing a boiler shell with holes and of transmitting heat through the shell is discussed, as well as the tendency toward equalization of stress through extension of the most-strained fiber. The tendency of the creep to equalize the stresses is also brought out. The method of extrapolation used by different authorities is discussed, and the conclusion is reached that more exact results are obtained by using the method employed by Prof. F. H. Norton in his book on the "Creep of Steel at High Temperatures" than by some other methods. 12 abstracted references. MFB(29)

The Expansion of Metals at High Temperatures. FDK. L. UFFELMANN. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Oct. 1930, pages 633–659.

Describes an optical interference method for measurements in 3 perpendicular directions on the same specimen and for use up to 800° C. Continuous temperature variation is made possible by a device for equalizing the temperature lag of the platinum resistance thermometer and the specimen. Observations were made during both heating and cooling. Results are given for Sn, Cd, Zn, Pb, Al, Cu, Co, Ni, brass and steel. Sn, Cd and Zn show pronounced anisotropic properties and over extended temperature ranges the cubical expansion coefficient curves fit neither the Quadratic nor Thieson's formula. Expansion coefficient curve for lead has definite changes at 170° C. and 245° C. The mean Al and Cu curves fit the quadratic relation. Brass with a maximum at 460° C. does not fit. For Co, Ni and steel, the expansion coefficient curve during heating is different from that during cooling, Co showing a sharp peak at 450° C. on heating and at 350° C. on cooling. Ni has a maximum in the heating curve at 340–360° C. RHP(29)

Needs of the Oil Industry for Metals at High Temperatures. E. S. DIXON (Texas Company). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 23–41, 3 tables.

Requirements for stills, cracking units, piping, hot oil pumps, etc., are summarized on the basis of a questionnaire to 270 refineries and equipment makers. Maximum, continuous temperatures (7 to 40 days) in pressure still work are reported from 775° to 1200° F., with one at 1400° F., maximum short-time temperatures (15 minutes to 2 hours) 1350° to 1500° F. with one report of 1775° F. Pressure varies from 335 to 1200 lbs. High temperatures are important for economy. Better material than KA2S is desired. Thermal conductivity is discussed in 18 replies, 10 calling it an important factor. Thermal expansion of high temperature alloys equal to that of carbon steel is desired by 8, while 7 think a different coefficient can be utilized by proper design. Resistance to fatigue, or repeated stress at high temperatures better than that of carbon steel is desired by 6, while 6 believe that creep and not fatigue, is the determining factor. Allowable stresses are discussed in 15 replies, with widely varying opinions. Some use the creep stress for 1% per year, with some factor of safety. Several use 6000 lbs./in.^{2} at 900° F. for carbon steel, and one reply gives 16,000 lbs./in.^{2} at 900° F. for 18–8. At higher temperatures, opinions vary, covering 2100 lbs./in.^{2} at 110° F., 4000 at 1200° F., 2000 at 1300° F., 4000 to 5000 at 1400° F. is said to be desired, though that stress is not now used. Fourteen replies give their own tonnage requirements for alloy tubes at a total of 19,000 tons. Of the replies, 23 reported corrosion by sulphur or its compounds, 8 erosion, 7 scaling, 6 acid corrosion, 2 each flue gas corrosion, caustic embrittlement, hydrogen embrittlement and general corrosion, 3 HCl corrosion, 1 no corrosion. 28 replies wanted the high temperature alloys readily weldable, 15 thought it desirable, but not imperative. 23 state that tubes must be rolled in, and material must stand it without work hardening. All replies desire that tubes swell before rupture, so as to give warning, which is not given by 18–8, but a few are willing to sacrifice such warning to obtain other outstanding properties. Large differences in practice and requirements among refineries are evident from this survey. HWG(29)

Properties of Bearing Metals at Normal and Elevated Temperatures. E. R. DARBY (Federal Mogul Corp.). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 218–233. 16 references, 6 figures, 3 tables.

Bearings often operate at temperature above atmospheric and their usefulness depends on their properties at those temperatures. Rolling mill bearings may operate at really high temperatures, but ordinary bearings may run at 100° to 300° F. In comparison to the melting points of the white metal bearings, say 400° to 500° F. and since some contain constituents that melt below 400° F., the operating temperatures are high. Room temperature properties are not safe guides. Especially in the automotive field, bearing duty is becoming so severe and operating temperatures so high, that the margin of safety on white metals is seriously reduced. Since the operating temperature is at least partly due to the bearing's own friction, the frictional and wear-resisting properties of bearing metals are important. Resistance to pounding, strength, hardness and toughness at operating temperatures are measures of the load carrying ability of the bearing. The bulk of the work on bronze bearings at elevated temperatures has been done at the Bureau of Standards, and the results are summarized. The tensile strength and elongation of bearing bronzes with 5 to 10% Sn, 5 to 18% Pb, both fall off sharply above 500° F. Resistance to pounding and impact resistance of sand cast Cu-Sn-Pb bronzes at 350° and 600° F. are higher than on chill cast. At these temperatures addition of Pb beyond 10% rapidly decreases, and addition of Sn beyond 6% rapidly increases, resistance to pounding. Addition of 4% Zn has little effect on high temperature properties; 0.05% P or 2% Ni decreased the resistance to pounding at 600° F. The tin base and lead base alloys lose strength and hardness very rapidly with increasing temperature. Tin base alloys containing lead "wipe" slightly below 360° F. the melting point of the Pb-Sn eutectic. Such low-melting impurities are harmful. The alkali and alkaline-earth-hardened leads have higher hardness at 325° F. than the usual tin or lead base alloys, but are not in general use in this country. Available data on high temperature properties of bronzes, of tin base and of lead base bearing metals are tabulated. HWG(29)

The Trend of Progress in Great Britain on the Engineering Use of Metals at Elevated Temperatures. R. W. BAILEY (Metropolitan Vickers), J. H. S. DICKENSON (English Steel Corporation), N. P. INGLIS & J. L. PEARSON (Synthetic Ammonia & Nitrates), *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 136–154, 4 references.

English metallurgists are interested in accelerated methods for determining creep, and some individuals advocate definite methods. Bailey *et al.* state, however, that these methods are only on trial. The desirable attributes of alloys for high temperature service are listed. Combination of all the attributes is unobtainable and the choice must be made on the basis of the most important requisites. Nickel does not, in itself, improve high temperature load carrying ability of steel. Of low alloy steels, 1% Cr, 1/4% V is good to 750° F. One of 2 1/2% Ni, 0.7% Cr, 0.3% Mo is good to 930° F. Above these temperatures, the steels have high creep. Plain 0.15% C, 0.35% Mo steel has remarkably high creep resistance to 1020° F. and its extended use is anticipated. Increase in Cr increases creep resistance and adds corrosion resistance. Austenitic Ni Cr steels have attractive creep resistance to 1110° F., but are prone to intercrystalline fissuring if heated in the range 930–1560° F. Tungsten helps. Automotive engine valves for heavy duty are trending toward use of austenitic Ni Cr steels in England. Embrittlement by many cycles of heating to 730° or 840° F. occurs in heat-treated mild steel. Nickel makes it worse. Sufficient molybdenum cures it. No steel which suffers from this effect should be used for parts stressed at high temperatures. High silicon cast iron with fine graphite resists growth and oxidation to 1650° F. Mild steel scales badly above 930° F. A 7 1/2% Cr steel, with carbon below 0.12% and perhaps with silicon up to 1% has good scaling resistance to 1290° F. above which the heat-resistant steels and alloys are required. The cast 65-20-15 Ni, Cr, Fe alloys must be cast sound for good service. Cast Ni, Cr, Al alloys are suggested for use to 2000° F. in sulphur gases. A plain 30% Cr is very resistant to oxidation and to sulphur, but is brittle cold. In Pilger mill mandrels and in extrusion presses, Ni, Cr or Ni-Cr alloys with Mo or W, usually Mo unless high red hardness is needed, are useful. For successfully coping with high temperature problems, engineers must rid themselves of the "mild steel complex." They must also go beyond the elastic theory in design. Creep data must be utilized. But data from different investigators and by different methods show wide divergence. Mathematical relationships between creep in tension and in shear are discussed in detail. There is need for more data on the thermal conductivity of alloys at 750° to 1250° F.

HWG(29)

Use of Metals at Elevated Temperatures in the Ceramic Industry. C. E. WILLIAMS (Battelle Memorial Institute). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 120–135, 8 references.

Drying ceramic materials at 300–500° F. before firing involves corrosion troubles, but high priced alloys are not warranted. Firing temperatures range from 1600° F. for common brick to 1775° F. for porcelain pyrometer tubes. Metal parts in kilns, sand seal plates, flue dampers, pans, kiln furniture, etc., are subjected to high temperature corrosion. Coal with 5% S is often used for ceramic firing. Fan blades for induced draft kilns are a special problem, with 18–8 on trial. Refractories reinforced with 0.20 C, 25 Cr, 17 Ni are being tried. A 28 Cr alloy became brittle. Cars for tunnel kilns may reach 1200° F. at the top, and only 400° F. at the bottom. Enormous expansion strains are set up and steel distorts. Cast iron in the upper sections has worked well. Design that allows free expansion is essential. For sand-seal plates, rolled steel, mounted to allow expansion and covered with a refractory wash, are adequate. Kiln "furniture," props, supports, etc., must not scale or deform up to 1650° F. For china, burnt above 2050° F., refractory furniture must be used. Electric furnaces would be ideal for china, but present metallic resistors will not serve. Vitreous enameling goes up to 1500° for cast iron and 1800° F. for steel. Supports reach higher temperatures and the furnace itself may be several hundred degrees higher. No scaling or deformation of supports is allowable. Points must be kept sharp by grinding. The alloys should be weldable. Some enamels appear to attack the temperature-resistant alloys. 18–8 scales, and calorizing it is being tried. Alloys of 67 Ni, 20 Cr; 60 Ni, 30 Cr; 20 Ni, 32 Cr; and 37 Ni, 18 Cr are all in use. Warpage is bad, as a warped support has to be straightened; this ultimately causes breakage. Making supports symmetrical and turning them over from time to time helps. Monel cast iron (14 Ni, 6 Cu, 2 Cr) supports used at 1560° F. outlast ordinary cast iron 10 or more to 1. In the glass industry, plungers to force the glass into molds, may be made of cast iron with 3% Ni, but are hard to cast free from blowholes. Cr plating or use of 65 Ni, 15 Cr is promising. Glass molds must be machinable, not stick to the glass, take a polish, operate at 900–1100° F. with the face at 1800–2400° F. Gray iron with a somewhat chilled surface is used. Monel cast iron, (Ni-resist), and 3 to 5% Ni cast iron are in use. Steel of 0.20 C, 0.75 Ni, 14% Cr is said to be good. High Ni-Cr alloys have not made much headway. Cr plating on heat-treated, high-test cast iron is quite successful. Various alloys, Monel cast iron (Ni-resist) and 60 Ni, 30 Cr or Cr plating are in use for sheet and plate glass rolls and tables. In lehrs heated by sulphur-bearing fuel, operating at 1000–1400° F., cast iron has behaved better than the Ni Cr alloys. Still better results are obtained with Ni-resist cast iron. Muffles in indirect fired lehrs must stand over 2000° F. Here 65 Ni, 15 Cr or steel with 0.25 C, 0.50 Ni, 28 Cr is used. Driving chains in continuous lehrs are of malleable iron or cast iron with 3 to 7% Ni, 1 1/2 to 3 1/2 Cu. Lehr rollers for plate glass of mild steel Cr plated have given very good results. The glass industry needs a metallic pyrometer protection tube to stand continuous immersion at 2000° F.

HWG(29)

Seek Metals to Withstand Higher Temperatures. *Steel*, Vol. 89, July 2, 1931, page 48.

A brief article describing the symposium on Effect of Temperature on the Properties of Metals, presented in Chicago, on June 23, 1931.

WAT(29)

Power Station Temperatures and Tensile Strength. *Metal Industry*, London, Vol. 38, June 19, 1931, pages 617–618.

A brief résumé of the subject. The tensile strength of a 0.37 C steel is given at 900° C., yield point and proportional limit values are given to 500° C. Tensile strength values are given on a manganese bronze and a gunmetal to 450° C. Corrosion and creep encountered in power stations are discussed very briefly. An interesting table is given showing temperature and pressure increases in power station practice since 1912. The maximum pressure in 1912 was 275 lbs./in.^{2} at 506° F. In 1930 a pressure of 1568 lbs./in.^{2} was reached in Vitkovice, Czechoslovakia, at 932° F. One experimental plant (location not given) has reached a pressure of 3200 lbs./in.^{2} at 706° F. In this connection there is an interesting article in *Power*, June 30, 1931, pages 1028–1031, which states that the steel works at Vitkovice are now planning to operate at 1900 lbs./in.^{2} at 900° F. The article describes the values and boiler fittings, from a standpoint of design rather than material used. The type of steel was not given other than one having a tensile strength of 78,000–92,000 lbs./in.^{2} and being rustless.

WAT(29)

Engineering Requirements in the Automotive Industry for Metals Operating at High Temperatures. A. L. BOEGEHOLD (General Motors Company) and J. B. JOHNSON (Army Air Corps). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 95–119, 11 tables, 15 references.

Requirements of pistons are tabulated. Cast iron and aluminum alloys each have advantages. Maximum piston head temperatures are 700° F. for Al, 900° F. for cast iron. Methods of compensating for high thermal expansion of Al are discussed. An Al alloy with 14 Si, 2 Ni, 1 Mg and 3/4 Cu has a relatively low coefficient. This also has good wear resistance. If used in cylinder sleeves of cast iron containing 14 Ni, 6 Cu and 2 Cr, which has a high coefficient, mutual expansion difficulties are minimized. 7 alloys for Al pistons are listed, as are 3 cast irons. These 3 contain either 0.35 Mo, 0.15 Ni or 0.30 Cr. In small bore, multicylinder engines, cast iron pistons have advantages over Al. Mg alloy pistons have no advantages over Al. An 80 Be, 30 Al piston would be ideal if beryllium were cheap enough. Valves in proper design may reach 1000° to 1450° F. and under unfavorable conditions, 1500° to 1600° F. If the valve stem could be sufficiently work-hardened, austenitic corrosion resistant steels would make the best valves. Most valve steels for severe conditions contain 0.40 to 0.60 C, about 9% Cr, 3 1/2 Si, and are improved by addition of 1/2% W. High temperature strength is satisfactory, but corrosion resistance to exhaust gases from fuels treated to eliminate knock needs improvement. Cylinders have greatest difficulty in valve seat wear. With proper lubrication and air cleaning cylinder wear is negligible. A dozen compositions of cylinder iron are tabulated, mostly containing Ni and Cr. Valve springs operate a 175–250° F. Failure is by fatigue, and is prevented by proper design. 5 steel compositions are mentioned. 9 piston bearing bronzes are listed, that are used with cast iron pistons at 300° F. Connecting rod and main crankshaft bearings have the most severe service of any in the auto, with shock loads of 2000 lbs./in.^{2} projected area, and run up to 400° F. with rubbing speed up to 2750 ft./min. Babbitt bearings, operated near 400° F. soon fail, as their high temperature strength is low. Failures of tin base babbitt with 7 1/2 Sb, 7 1/2 Cu are common. Reducing the lining thickness to 1/32" or less is helpful, since deflection or permanent set is reduced and heat dissipation facilitated. Even this will not cure failure on some engines, and it is necessary to keep lead out. The hard babbitt without Pb has 1600 lbs./in.^{2} tensile, and 116% elongation at 400° F. If 2% Pb is introduced, the figures fall to 500 lbs./in.^{2} and 1%. Bi in a Sn-base babbitt is very harmful. Resistance to shock and cracking is improved by cutting Cu below 7 1/2%. The trend to higher bearing loads will soon make it necessary to abandon the babbitts and go to bearing metals of higher melting points. Diesel engine pistons need high head temperatures so cast iron is used in small ones. In large, internal cooling or use of Al, is required. The high explosion temperature makes it hard on valves if there is leakage. Very high strength iron is needed for cylinder and cylinder head, and there is danger of cracking from differential expansion. Aviation engine pistons may operate at 650° F., exhaust valves at 1600° F., air cooled cylinder heads at 600° F. Compositions and physical properties are given for these and other parts. Valve seats and guides may be of aluminum bronze, containing Fe or Fe and Ni. Austenitic Ni Cr steels have suitable properties also. Cylinder heads are Al alloys, 3 compositions being given. Mg alloys have too low strength and thermal conductivity. Cylinder barrels are 0.50 C steel. Some other alloys tried showed too much wear. Nitrided cylinders are being used in France. Corrosion resistance against doped fuels is essential. Aircraft pistons are always Al alloys. Valves may be of Cr-Si-W steel. Several other compositions are referred to, and a list of detailed requirements given. Corrosion of exhaust stacks is a problem. 18–8 is generally used. High bearing pressures and temperatures have called for steel backs on babbitt bearings, to give stiffness, and this combination has been replaced with alloys containing 25 to 38% Pb, 1/4 to 5% Sn, balance Cu. HWG(29)

Nickel and Nickel Alloys, Other than the Nickel-Chromium-Iron Group (at High Temperatures). C. A. CRAWFORD & R. WORTHINGTON (International Nickel Co.). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 403–431, 23 figures, 23 references.

What might be termed the "non-ferrous" nickel alloys are considered in this paper, especially commercial Ni, Monel, Ni Cu, and Ni Cu Zn alloys. These have creep resistance better than most other copper alloys, but below that of carbon or alloy steels, or the NiCr Fe heat resisting alloys. On account of their corrosion resistance they serve for the lower range of high temperature service. Available data are plotted. Ni and Monel are more resistant to creep than the other alloys in this class, but it is not known which has the better resistance, nor are the high temperature effects of addition elements well understood. Cold worked material not heated to its recrystallization temperature, retains its strength at lower temperatures and may even harden somewhat. The recrystallization temperature depends on the degree of cold work. Up to the recrystallization temperature, short time tensile tests have value. They also have value in revealing hot-short ranges and in showing workability at very high temperatures. Above some 600° F., creep tests show lower load carrying ability than would be expected from short time tests. Resistance of the alloys to oxidation, to alternate oxidizing and reducing conditions, to attack by steam, by hydrogen and nitrogen, as in nitriding containers, to sulphidization under oxidizing and reducing conditions and to attack by molten metals is discussed. HWG(29)

Effect of Elevated Temperatures on Certain Mechanical Properties of Gray Cast Iron and Malleable Iron. J. W. BOLTON (Lukenheimer Co.) & H. BORNSTEIN (Deere & Co.). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 299–321, 60 references.

There are no available creep data on cast or malleable iron. Short-time tensile tests show quite constant strength and hardness to 800° F. The modulus of elasticity of cast iron is lowered as temperature rises, but does not drop much to 750° F., though it drops materially at 1000° F. The larger the cross-section of the casting the more noticeable is the temperature effect on modulus. High test cast irons hold their relative strength up to about 800° F., the curves being similar in form to those for weaker irons. Heating for 500 hrs. at 850° F., then testing at room temperatures produces only slight loss of strength, but this treatment at higher temperatures drops the strength vastly. Addition of 1/2% Cr reduces the loss of strength. "Growth" of cast iron is a serious factor in high temperature uses. This is discussed in some detail. Prevention of oxidation in use, use of white iron, of Cr and probably of W or Mo, and low total carbon, are ways of minimizing growth. It can be prevented by use of enough alloying elements to avoid allotropic transformations, as in the case of "Niresist" (14 Ni 5 Cu, 3 Cr). Raising Si to 4 to 10% is also used. Gray iron castings are allowed for pressure-containing parts up to 450° F. by the A. S. M. E. boiler code, which is conservative. Where growth is not serious gray iron may serve at 700° or even 800° F. Above that there is too much danger of graphitization. Low temperatures do not appear to increase the brittleness of cast iron. Design for low temperature service should allow for thermal contraction and consequent stress. Malleable does not grow, unless 1300° F. is exceeded. Malleable is seriously brittle at temperatures below 32° F. Conditions that lead to a malleable prone to embrittlement when galvanized bring about such brittleness at higher temperatures, while lots that are not prone to galvanizing embrittlement retain toughness to lower temperatures. HWG(29)

Bending of Curved Pipes. SABIN CROCKER (Detroit Edison Co.). *Heating, Piping and Air Conditioning*, Vol. 3, May 1931, pages 399–403.

The theories advanced by a number of investigators regarding the flattening of the circular cross section of curved pipes during flexure are supported by a comprehensive series of tests. The formulas presented by different investigators are in essential agreement. Their results taken together offer conclusive proof that flattening of the circular cross section of curved pipes during flexure must be taken into account in an accurate flexibility analysis. These formulae are presented and discussed in this paper. The theory of flattening takes into account the fact that curved pipes behave differently during flexure than do straight pipes or solid bars. It applies to initially curved pipes, such as quarter bends, U bends and the like. Briefly, flattening of curved pipes during flexure comes from the fact that tension and compression stresses induced by flexure cannot act in a straight line and consequently must have components toward the neutral axis of the cross section. The operation of piping in power plants and oil refineries at temperatures about 750° F. has led to the consideration of creep in setting up safe working stresses due either to fluid pressure or expansion. Bursting stress is not relieved by plastic flow or creep. The author's company is now basing the design of piping for temperatures in excess of 750° F. on the following considerations (a) transverse bursting stress to be kept in safe limits within limiting creep stresses of 1% in 100,000 hrs., (b) the equivalent stress = maximum stress minus minimum stress and not to exceed 15,000 lbs./in.^{2} This limit of equivalent stress is considered safe for carbon steel pipe. WAT(29)

Engineering Requirements and Trends for Metals in the Ferrous Metal Industries. J. C. WOODSON (Westinghouse Elec. & Mfg. Co.). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 51–76.

Discussion based on experiences of 22 alloy makers, furnace builders and consulting engineers. Resistor alloys for electric furnaces are 80 Ni 20 Cr, relative life 7.6; 59 Ni 16 Cr 23 Fe, relative life 3.2; 34 Ni 20 Cr 42 Fe, relative life, unity. Cast resistors are 67 Ni 20 Cr 13 Fe for high temperatures, 37 Ni 19 Cr 44 Fe, for lower ones. Expansion, creep and growth are the main difficulties. The alloys serve very satisfactorily, but other alloys to give furnace temperatures of 2000–2500° F. are needed. Ovens operating up to 850° F. have some difficulties due to moisture condensation and rusting during shut-downs. Ingot iron serves to 600° F., above that stainless steel (11–14 Cr) is advisable. Lead, solder, tin type metal and babbitt pots are cast iron or cast steel. These are attacked by high-tin alloys. Ni-Cr alloys are also attacked by tin. Neither will these, or high Cr alloys, resist zinc, so galvanizing pots are made of ingot iron or boiler plate. Failure is due more to operating conditions than to material of the pot. Precautions are given. Pot life with pots 1½ to 2″ thick is 1 to 6 months. Improvements are needed. Aluminum melting pots are cast iron. Ni-Cr alloys are attacked. Fire box temperature is 1700–2000° F., excessive for cast iron, so the pots grow, blister and crack. Improvement should be possible. Structural parts for heat-treating furnaces are made in a wide variety of compositions. In one group the Cr is about 15 to 20% with Ni ranging from 80 to 20% with about 37 Ni, 19 Cr most widely used. Where presence of nickel in large amounts is detrimental due to special corrosive conditions, the Ni may run 6 to 20%, being used for ductility, with Cr from 18 to 30%. The Cr-Fe alloys are also used. Woodson prefers the 37 Ni, 19 Cr alloy unless corrosive conditions are present, but some makers believe that 42 Cr, 12 Ni is just as good. The furnace atmosphere (oxidizing, neutral, reducing or sulphur-bearing) has as much effect on life as temperature does. Nitriding furnace containers offer difficulties. Alloys with no Ni or with Cr predominating have not been as successful as pure Ni or Monel. More work is needed. Alloys for use in heat-treating furnaces, batch and conveyor types, operating at 1350–1650° F. may fail from oxidation or chemical attack if the composition is not suited to the conditions. High impinging gas velocity may wash away the protective film and this may be a greater source of trouble than temperature itself. Mechanical failures are generally due to a design which disregards the forces of thermal expansion. Design in which many small pieces are used is better than one calling for very large pieces. This is illustrated by photographs. Casting defects that would be unobjectionable at normal temperatures, may be fatal. If the ambient gas is sulphur-free, 67 Ni, 20 Cr or 37 Ni, 19 Cr are generally used. Most steel-mill furnaces use 24 Cr, 12 Ni. Some of these operate at 2000° F., but it is not recommended to go so high in general practice. In sulphur gases, 28 Cr, no Ni, is used, but is subject to embrittlement. Carburizing boxes, used at 1450–1750° F. are made of various compositions, with 60 Ni, 12 Cr apparently in the lead. With high Na_2CO_3 or in sulphur gases, 28 Cr, 10 Ni or 35 Ni, 15 Cr are used. Proper design has much to do with the life of the box. Annealing boxes are so heavy that only the cheaper 18 Cr, 8 Ni alloys are used, best in boxes fabricated from rather thin sheet. For malleabilizeing, at 1600–1850° F. white or gray cast iron or cast steel are used. Woodson suggests the use of fabricated sheet boxes, but expects that electric furnaces and short-time cycles will ultimately make boxes disappear. Pot type furnaces for lead, of 66 Ni, 20 Cr give 3000 to 6000 hours life at 1500° F. Bi or Sb in the lead accelerate corrosion. The life ought to be doubled. Cyanide pot failures are not well enough understood. Various alloys give both good and bad results. A table showing type of service, temperatures encountered and materials in use in open-hearth steel plants, covering 60 items used at 150° to 3000° F. is appended. HWG(29)

Properties of the Rare Metals for High Temperature Service. W. H. SWANGER (Bureau of Standards). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 450–462, 16 references, 1 table.

Data on physical properties of Au, Ag, Ru, Rh, Pd, Os, Ir, Pt, W, Mo, Ta and Cb are tabulated. Mechanical properties of these metals and their alloys are little known. Ru and Os oxidize readily, also Ta and Cb. Rh, Pd and Ir form oxides but the oxides dissociate at high temperatures so that the metals are serviceable for high temperature use. W and Mo are usable in reducing atmospheres or in vacuo. Some high temperature applications of several of the metals are referred to. HWG(29)

The Mechanical Properties of Aluminum and Magnesium Alloys at Elevated Temperatures. R. L. TEMPLIN & D. A. PAUL (Aluminum Co. of America). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperrture on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 198–217, 16 tables, 12 references, 16 figures.

The properties are tabulated and plotted in great detail. Most past data has been obtained by short-time tensile tests to 800° F. Data are presented for various cast and wrought aluminum alloys, heated for 50 or 100 days at 400° and 600° F., then given short-time tensile test at those temperatures, which indicate that the results of short-time tests without preliminary prolonged heating may be misleading. Growth at high temperatures is discussed. The data are too profuse for abstracting. Aluminum alloys, fortunately for aircraft uses, are not injured by low temperatures. They are unique in that both strength and ductility increase at low temperatures, even down to −320° F. All data on magnesium alloys have been obtained by short-time tests. Low temperature strength increases on pure Mg, and stays about constant on most of its alloys, but ductility and impact strength are lowered at low temperatures. At high temperatures ductility increases but strength drops rapidly, yield point even more rapidly. The available data are tabulated. HWG(29)

Experiences with Alloyed and Higher Carbonized Boiler-Plate Materials. (Erfahrungen mit legierten und höher gekohlten Kesselbaustoffen.) FIEK. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 14, 1931, pages 336–337.

The testing laboratory of the Rheinische Dampfkessel-Ueberwachungsverein has published results of tests made on some special high-grade steels for the construction of boilers. The reader is referred to tables which show the exact chemical analysis of 11 steels and the elastic limit tensile strength and elongation at 20° and 400° C. Ha(29)

Endurance of Alloy Steels in Steam. T. S. FULLER. *Metal Progress*, Vol. 20, July 1931, pages 79–81.

Advance information on a paper to be presented at the September Convention of the American Society for Steel Treating. It is an extension of the work done in the laboratory of the General Electric Company and reported in the A. I. M. E. in 1930. (See *Metals & Alloys*, Vol. 1, June 1930, page 565.) The results are presented on a Data Sheet which is included in the article. The steels tested were: 3.5% Ni, an Fe-Cr alloy with 0.10% C and 12.5% Cr, 3 nitrided steels 0.36% C 0.18% C and 0.20% C, all heat treated, and an 18–8 austenitic group with 0.065%, 0.085% and 0.15% C. Some of the conclusions are: the nickel steel and the chrome-iron alloy, in the absence of appreciable quantities of liquid water and oxygen in the steam, were not seriously affected to pressures of 220 lbs. and temperatures of 700° F.; due to the presence of liquid water and oxygen, the steam jet-atmosphere endurance values of these steels were but 41% and 54% of the corresponding air-room temperature values. In the nickel steel, if corrosion be severe, the endurance values are not a function of the initial tensile properties of the material. The damaging effect of the simultaneous presence of stress and corrosion is emphasized. Chromium plate offered considerable protection to the nickel steel against corrosion in the steam jet-atmosphere test. No damaging effect of the pre-corrosion treatment on the chrome-iron was evidenced by any of the tests. The ratio of the air-room temperature endurance limit to ultimate strength was higher in the case of the nitrided nitriding steels than in that of any of the other tested. The endurance values of the nitrided steels dropped off rapidly with increasing temperatures. The ratio of the steam jet-atmosphere to air-room temperature endurance values was higher in the case of the nitrided nitriding steels than in that of the other steels tested. The 60-lbs. 300° F. steam endurance value of notched nitrided specimens ranged from 74 to 83% of that shown by the corresponding unnotched specimens. The endurance properties of the 18–8 chrome nickel type of alloy are seriously affected by long intervals of time at temperatures of 1200° F. and above. In the hot rolled condition the endurance values of this alloy bear a relationship to carbon content. This relation, however, disappears after drastic treatment at elevated temperatures. WAT(29)

High Temperature Creep Properties of Wrought Carbon and Low Alloy Steels. A. P. SPOONER (Bethlehem Steel Co.) & F. B. FOLEY (Midvale Co.). *Preprint for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals*, June 1931 meeting *American Society for Testing Materials*, pages 255–259.

A series of 64 steels, with 0.20 to 0.50% C, some being plain carbon steels, other containing up to a total of 5% of alloying elements, Ni, Cr, W, V and Mo are tabulated in respect to stresses producing a rate of elongation of 1% in 100,000 hrs. About a quarter of the steels were tested by Hatfield or Eckhardt, with "accelerated!" tests that purport to indicate long-time creep properties but which have not yet been proven to do so. The balance were tested by long-time methods. The steels with best load carrying ability at 1000° to 1100° F. are in general those containing Cr and either W or Mo as alloying elements. A 0.38% C, 0.95% Mn, 0.57% Cr, 0.86% W steel is about as strong at 1000° F. as a plain 0.40% C steel is at 700° F. One of 0.39% C, 0.87% Cr, 0.21% Mo is as strong at 1000° F. as the 0.40% C steel is at 600° F. Data in the literature on tests at loads that produce 1% flow in 1000 hrs., or that indicate "limiting creep values" of less than 1000 lbs./in.^{2} have been omitted as of no interest from the design standpoint. HWG(29)

The Red-Brittleness of Steel by Metals. (Ueber Rotbruch des Stahls durch Metalle.) H. SCHOTTKY, K. SCHICHTEL & R. STOLLE. *Krupp'sche Monatshefte*, Vol. 12, May 1931, pages 100–105.

After a review of former investigations of this subject, tests are described in which the hot steel was bent and the metal was either strewn on or the steel was dipped in it. From the tests, the following conditions for the occurrence of red-brittleness were found: (1) direct contact of the steel with one alloy which is at least partly liquid; (2) the existence of an extensive ability to mix between the iron and the metal the principal constituent of the liquid alloy; (3) the existence of a sufficiently high tensile stress in the steel which is wetted by the metal. Many photographs and micrographs illustrate the article and 18 references are cited. Ha(29)

The Load Limit of Steam Turbines. (Die Grenzleistung von Dampfturbinen.) H. KLUGE. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Feb. 1931, pages 49–54.

Gives present-day conception of load limit, also thermodynamic calculations of load limitation blade limits, limit of blade diameter, the closest margin permissible and a table of load limits. Rather large variation in the absolute and relative velocity depending on the variation of the cross-section of the blade. Valuable equations for blades are given; they are the most dangerous part of the turbine. The final loading depends on the limit values at high temperatures. MB(29)

REDUCTION METALLURGY (31)

The Reaction Between Magnetite and Ferrous Sulphide: Part II. F. S. WARTMAN & G. L. OLDRIGHT. *Bureau of Mines Report of Investigations*, 3072, Mar. 1931, 10 pages.

Silica and magnesia accelerate, whereas lime, alumina and cuprous sulphide hinder the reduction of magnetite by FeS. Orthoclase, anorthite, albite and kaolin also accelerate the reaction. AHE(31)

Lead Smelting and Zinc Fuming at Tadanac, B. C. GEORGE J. YOUNG. *Engineering & Mining Journal*, Vol. 131, May 11, 1931, pages 415–419.

The third of a series of articles on the technical operations of the Consolidated Mining & Smelting Co. of Canada, Ltd. Selective flotation has been steadily improving. The zinc plant now receives a zinc concentrate containing about 50% zinc, and a little over 3% lead, and the lead smelter a product containing 70% lead with less than 5% zinc. Zinc is recovered in the hydrometallurgical treatment and the Dwight-Lloyd sintering furnaces successfully cope with the fine lead concentrate. A flowsheet is shown, also a layout of lead blast furnaces and zinc plant. WHB(31)

Recovery of Zinc from Lead Blast Furnace Slag. RUSSELL B. CAPLES (Anaconda Copper Mining Company). *American Metal Market*, Vol. 38, Apr. 29, 1931, page 3.

Presented at Annual Convention American Zinc Inst., St. Louis, Mo., April 1931. Consists of slag treating furnace, 300 tons molten slag capacity per day. Furnace is of rectangular cross-section; sides, ends and top made of water jackets; bottom of water cooled cast iron plates resting on concrete foundation; furnace charge 35 tons. Furnace cycle 30 min. charging, 140 min. blowing and discharging, or total 2 hrs. 50 mins. per charge. Zn content of slag from furnace runs 3%. Coal consumption 30 to 40% of weight of slag treated (10,000 B. T. U. coal). Air averages 8,000 ft.^{3} free air/min., under 14 lb. pressure. DTR(31)

Flotation Tests on Converter Slag. FRANK S. WARTMAN. *Report of Investigations* No. 3068, *United States Bureau of Mines*, Apr. 1931, 7 pages.
It is possible to recover by flotation about 90% of the Cu content of a chilled converter slag containing 3% Cu and to obtain flotation concentrations containing 35% Cu. Reagents were 0.14 lb. No. 5G. N. S. pine oil/ton of slag, 0.1–0.15 lb. amyl xanthate, 1.25–3.0 lb. H_2SO_4, and 0.12–0.25 lb. P. E. oil. AHE(31)

The Recovery of Vanadium Pentoxide from Zinc Ores. *Chemical Engineering & Mining Review*, Vol. 23, Mar. 5, 1931, pages 215–216.
Vanadium pentoxide is recovered from zinc-iron-vanadate. The process developed by R. H. Stevens and employed at the Rhodesia Broken Hill Development Co., Ltd., is described. Vanadium is precipitated from the zinc solution as zinc or iron vanadate or a mixture thereof, and is filtered in pressure filter presses. After washing, the precipitate is discharged and transported to the storage-bin. It is fed from the storage bin to the grinding mill where it is made into a slurry. The mill discharge is pumped to storage tanks where it is kept agitated. Caustic soda is produced by the interaction of lime and sodium carbonate in the form of a liquor containing 75 g./l. caustic soda. This reacts completely with the vanadium in 1–2 hrs. at 100° C. The sodium vanadate solution is treated in the precipitation tank with sulphuric acid until the free acidity is about 5 g./l. sulphuric acid. Steam brings the temperature to 95° C. Excess of acid generally lowers the precipitation efficiency, but may yield a purer product. Impurities remain in solution. In the filter presses the vanadium hydrate is washed to remove all soluble salts. From the bins the hydrate is fed to a gas-fired melting furnace. The oxide produced is 90–95% vanadium pentoxide and is practically free from phosphorus and sulphur. The balance consists of alkalies with small amounts of silica and iron. WHB(31)

The Preparation of Raw Materials at the Röchling Iron & Steel Works at Völklingen. (Die Aufbereitung der Rohstoffe bei den Röchlingschen Eisen- und Stahlwerken, A.-G., in Völklingen.) A. WAGNER. *Stahl und Eisen*, Vol. 51, Feb. 19, 1931, pages 217–225.
Report 117 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. The article gives a detailed illustrated description of the raw materials dressing plant of the Röchling Steel Works, including ore crushing plant, ore screening plant and ore sintering plant. The economies are considered. By certain technical changes of the coal washing plant, it has been possible to decrease materially the ash content of the coal thus improving the quality of the coke made. GN(31)

Thin-Walled Blast Furnaces. JIDRICH SAREK. *Rolling Mill Journal*, Vol. 4, Oct. 1930, pages 515–518; *Iron Age*, Vol. 126, Dec. 11, 1930, pages 1770–1771.
From a paper read before the Iron & Steel Institute, Oct. 5, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 20. MS + VSP(31)

Gas Flow in Blast Furnaces. *Iron & Coal Trades Review*, Vol. 120, Feb. 2, 1930, page 318.
Abstract of *United States Bureau of Mines, Report of Investigation* 2978, by S. P. Kinney. This report covers part of the material given in United States Bureau of Mines Technical Paper 442 by the same author. See *Metals & Alloys*, Vol. 1, May 1930, page 528. RHP(31)

Prolong Iron Ore Resources by Beneficiation. *Iron Age*, Vol. 126, Dec. 25, 1931, pages 1927–1929.
Taken from discussion at the annual meeting of the Iron & Steel Division of the American Institute of Mining and Metallurgical Engineers held during the National Metal Congress. Ores of indeterminate value and some which were worthless are being successfully treated. Probable life of Lake Superior iron ore is about 30 yrs. Low grade ores may be treated, first by reducing to metallic state, crushing to suitable size and concentrating magnetically. High grade ores to be used in electric or open-hearth furnace and the low grade in the blast furnace. VSP(31)

The Iron Ore Deposits of South Africa. (Die Eisenerz-Lagerstätten Südafrikas.) H. SCHNEIDERHÖHN. *Archiv für Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 269–276; *Stahl und Eisen*, Vol. 51, Jan. 15, 1931, pages 68–70.
Report 25 of the Ore Committee of the Verein deutscher Eisenhüttenleute. According to the general classification of the origin of ore deposits, the ore deposits of South Africa have been studied. There are found to be deposits of magmatic, sedimentary and metamorphic origin. The amount of the deposits and the average composition of the ores is given. Some of the magmatic deposits contain between 2% and 20% TiO_2. An export of the South African ores does not seem to be economical, but a home iron industry can be based on these deposits. English and German capital is at present building a steel mill near Pretoria. GN(31)

Fine Chemicals as Precious Metal Precipitants. E. T. ELLIS. *Metal Industry*, London, Vol. 38, Apr. 10, 1931, pages 377–378.
Among the chemicals used to precipitate metallic gold from acid solutions of gold nitrate and chloride are ammonium potassium and sodium oxalates. Antimony trichloride, ferrous sulphate and stannous chloride precipitate metallic gold from chloride solutions. Magnesia, potassium hydroxide and zinc oxide precipitate the oxide from chloride solutions, and potassium cyanide precipitates the cyanide. PRK(31)

Graphical Carbon Balance of the Blast Furnace. T. J. ESS (Republic Steel Corp.). *Iron & Steel Engineer*, Vol. 8, Apr. 1931, pages 173–176.
The author proposes a graphical method of obtaining a carbon balance on the blast furnace. WLC(31)

Progress in the Flash Roasting of Sulphide Ores. HORACE FREEMAN. *Canadian Mining & Metallurgical Bulletin* No. 230, June 1931, pages 715–725.
Flotation pyrite containing 2 to 3% moisture and about 50% of S, or lump pyrite ground in a ball mill, is burned in a special furnace. Operating data are given. Steam is raised with the hot gases (1 lb. per lb. pyrite), the sinter (65% Fe) is used for sponge iron, and SO_2 is available for use. AHE(31)

Reduction of Zinc Oxide by Methane or Natural Gas. H. A. DOERNER (U. S. Bureau of Mines). *American Metal Market*, Vol. 38, Apr. 30, 1931, pages 3, 5, 10.
Reprinted from U. S. Bureau of Mines Report of Investigations 3091. Thorough study of this process. DTR(31)

Modern Blast-Furnace Practice. JAMES R. YOUNG & R. C. IRVING. *Proceedings Australasian Institute of Mining & Metallurgy*, No. 79, Sept. 30, 1930, pages 215–57.
Modern developments are more in the nature of refinements than in changes of a radical nature. The tendency is to have bigger furnaces, particularly in the hearth, with steeper boshes. There is a steady increase in stock-line diameters and an increase in stock-line areas compared with the large bell. This is to reduce the velocity of the top gases and so minimize dust losses. AHE(31)

The Production and Supply of Foundry Pig-Iron. *Foundry Trade Journal*, Vol. 44, Apr. 23, 1931, pages 294–296.
Report of paper by H. G. Scott on the blast furnace, its limitations, and its relations to the cupola, together with a discussion of the paper. OWE(31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

The Development of an Enamel on a Eutectic Basis. HAROLD E. SIMPSON. *Enamelist*, Vol. 4, Jan. 1931, pages 28–46, 54–55.
Object of investigation was to develop a eutectic solvent for an enamel by the combination of several eutectics, then to add silica to increase the refractoriness of the enamel up to the limit of its capability to dissolve silica without endangering its bond to the metal body. Study of eutectic composition of the $RO-B_2O_3-SiO_2$ systems. The $Na_2O-B_2O_3-SiO_2$, $K_2O-B_2O_3-SiO_2$ and $PbO-B_2O_3-SiO_2$ deformation eutectics being known, a knowledge of the $CaO-B_2O_3-SiO_2$ system was necessary. A study of the high B_2O_3 area of this system was made at approximately 4% intervals. A member high in CaO and SiO_2 and which on repeated fusions showed practically 100% glass was selected as a practical member to blend with the $Na_2O-B_2O_3-SiO_2$ and the $PbO-B_2O_3-SiO_2$ eutectic to form a eutectic solvent. Combinations of these eutectics and the $CaO-B_2O_3-SiO_2$ mixture were made and applied to cast iron by the dry process. Additions of SiO_2 were also made to these enamels up to 1.5 molecular equivalents. The physical properties of these enamels, such as brilliance, smoothness, texture, bonding power, resistance to acid attack, etc., were determined. MFB(32)

Moisture Expansion of Glazes and Other Ceramic Finishes. H. G. SCHURECHT & G. R. POLE. *Bureau of Standards Journal of Research*, Vol. 6, Mar. 1931, pages 457–463.
Research for ascertaining why some glazes are more resistant to "moisture crazing" than others revealed the fact that certain glazes expand, because of the action of water, similarly to some of the ceramic bodies to which they are applied. Although a control of this type of expansion is very important in fitting glazes to bodies, it has not been previously considered. Its importance should be evident at once when it is considered that a large "moisture expansion" in a glaze, or other finish, is in many cases an indication that the glaze will not be so liable to craze when the ceramic ware of material on which it is used is exposed to moisture. This follows since the glaze and the body on which it goes and which is ordinarily very susceptible to this kind of expansion will then increase in size simultaneously and more nearly at the same rate. Such conditions lessen the tendency of the body expansion to cause tensile stresses in the glaze. In this investigation specimens of various finishes were subjected to steam at 150 lbs./in.^{2} for an hour because it was known that this treatment of such materials produces similar effects to those caused by long exposure to weather. This artificial weathering treatment caused in lustrous glazes an average expansion of 0.004%, in mat glazes 0.011%, in vitreous slip finishes 0.005%, and in porous slip finishes 0.033%. The moisture expansion of one of the mat glazes was 30% of the average obtained for a ceramic body having an absorption of approximately 12%. This proclivity of ceramic finishes to expand by the absorption of moisture can be controlled in their manufacture. (32)

Soil Pipe Coated, Wrapped Mechanically in Plant. *Steel*, Vol. 87, Sept. 25, 1930, pages 57, 60.
Describes machine developed by the Hill, Hubbell & Co. division of the General Paint Corp. for application of coatings and wrappings at the pipe mills. Pipe is fed into the machine and rotated as it is moved forward. It is scraped, coated with a bitumen, and wrapped spirally with a layer of felt and a layer of heavy kraft paper. MS(32)

Aluminum Paints. (Aluminiumfarbe.) IV–VI. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Sept.-Oct. 1930, pages 19–32.
Aluminum paints are made of aluminum bronze and oil or linseed oil. They are now used extensively for protective coatings and as decorative paint. The various compositions are described. Standardization, tests and resistance to weather are discussed. Ha(32)

Chemical Characteristics of Cement Pipe Lining. E. L. CHAPPELL (National Tube Company). *Industrial & Engineering Chemistry*, Vol. 22, Nov. 1930, pages 1203–1206.
Presented before the Division of Industrial & Engineering Chemistry of the American Chemical Society at the September Meeting in Cincinnati, Ohio. 7 references. The data presented show that cement linings in use from 40 to 60 years have gradually lost their lime content, which has been replaced by iron hydroxide. This change is found to take place more rapidly in hot water. The replacement of lime by iron hydroxide does not result in the disintegration of the lining, nor does it appear to impair the protectiveness of the lining. Laboratory experiments show that pure silica sand in thin films greatly decreases the corrosion of cement and gradually becomes cemented into still more protective layers by the precipitation of iron hydroxide from the steel beneath. MEH(32)

Protection of Aluminum by the Lime-Method. (Aluminiumschutz nach dem Kalkverfahren.) FREITAG. *Oberflächentechnik*, Vol. 8, June 2, 1931, page 124.
Attention is called to the recently developed method of producing a grayish coating. By this method, the aluminum articles are boiled in a solution of 10 g. hydrated lime and 10 g. finely powdered gypsum for each l. of water. Ha(32)

Preparation, Use and Application of Aluminum Paint. A. C. CAMP. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, pages 701–704.
Al bronze powder is made by stamping Al into very small, thin flakes and is finished by a special polishing process which gives it a lustrous and brilliant surface. When mixed with a vehicle, the flakes come to the surface and form an almost continuous film of Al, which has much life and protective power because of its capacity to light. The powder is used with a wide variety of vehicles, the specific applications for which they are suitable being outlined. A "spar" varnish of just the proper consistency without thinning should always be used for exterior work. This type of Al paint is particularly adapted for application to metal surfaces. Amount of powder required to make a durable paint is about 20–25% by weight. MS(32)

Developments in Baked Finishes. WILLIAM J. MISKELLA. *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 627–631.
In removing oil and grease from metal surfaces, fire hazard and other objectionable features have been eliminated by the use of a cleaning compound containing a volatile solvent and an absorbent material such as Fullers' earth. A priming material made of a synthetic resin has been developed, which is not baked on until after the surface coat is applied. Discusses advantages. MS(32)

Finishing of Steel Bodied Tile. GEORGE D. HAINES (Porcelain Tile Co.). *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, pages 707–710.
Tile, formed from sheet steel and coated with vitreous enamel, is widely used for walls in the sanitary fixture industry. The steel body is blanked and formed in a progressive die, and is then cleaned, pickled, dipped in a neutralizing bath, washed and dried. The tile is given a ground coat, fired, and then the color coat is applied and fired. The ground coat has a higher fusion temperature than the color coat. Gives method of setting the tile. MS(32)

Oven Installation for Dipping and Baking Three Coats of Japan Continuously. J. B. NEALEY. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1403–1404.
Installation at plant of Hupp Motor Car Corp., Detroit, Mich. consists of 3 gas-fired japanning ovens on roof with 3 dip tanks on floor below and so arranged that a single conveyor serves both ovens and dip tanks. MS(32)

PATENT DEPARTMENT

An arrangement with Mr. W. M. Corse, Metallurgical Engineer, Washington, D. C., who operates an Engineering Information Service, enables us to publish a list of important patents from the United States, Canada, England, Germany, France, Switzerland, Denmark, Holland, Sweden, Norway and Italy.

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United States Patents

Note: Numbers of Reissue Patents are preceded by "Re."

Subject of Invention, Patentee, Patent No. and Filing Date.

Manufacture of stainless iron. A. L. Feild, 1,812,941, 12/18/26, renewed 1/14/31.

Apparatus for making wheel spiders. I. H. Judd, 1,812,959, 7/23/28.

Machine for bending sheet metal shapes. A Rafter, 1,812,982, 12/13/29; 1,813,951, 12/8/28.

Method of casting metals and alloys therefor. W. C. Smith, 1,812,992, 10/12/27.

Process of refining metals. W. C. Smith, 1,812,993, 6/21/29.

Process of case hardening. R. J. Cowan, *et al.*, 1,813,028, 3/8/30.

Mold for alumino-thermic welding of rails. J. H. Deppeler, 1,813,032, 8/-23/29.

Process for the treatment of zinciferous and composite ores by the volatilization of metallic elements. A. Folliet, *et al.*, 1,813,042, 5/27/29; France 5/30/28.

Tube expander and method of expanding tubes. K. A. Stenner, 1,813,096, 8/14/29.

Rolling mill. C. White, 1,813,129, 2/25/28.

Billet conveying apparatus for heating furnaces. M. K. Nye, 1,813,195, 2/12/30.

Lead alloy. R. J. Shoemaker, 1,813,324, 11/28/28; 1,815,528, 12/2/29.

Electric arc furnace and crane structure. 1,813,397, 6/18/30.

Steel ingot. W. H. Ramage, 1,813,507, 1/24/27 (Division of application filed 1/28/26).

Ingot mold. W. H. Ramage, *et al.*, 1,813,508, 3/22/30.

Process of making ferrous products faced with stable surface alloys. P. A. E Armstrong, 1,813,654, 3/30/29.

Hot-metal-working tool. P. B. Piersol, 1,813,677, 11/10/28.

Lap welding machine. E. Bryan, 1,813,727, 11/26/28.

Treatment of metal. F. J. Crolius, *et al.*, 1,813,840, 11/12/30.

Process of producing protective metal coatings. C. G. Fink, 1,813,842, 7/-23/25.

Aluminum alloy. H. C. Hall, *et al.*, 1,813,850, 9/30/30; Great Britain 10/1/29.

Casting ladle. F. G. Carrington, 1,813,381, 6/8/28.

Method of and apparatus for soldering. D. M. Boothman, *et al.*, 1,813,657, 9/12/28.

Annealing magnetic punchings. L. E. Hildebrand, 1,813,802, 2/11/29.

Process for the production of beryllium alloys, in particular those with a high beryllium content, by means of fused liquid electrolysis. H. Fischer, 1,813,919, 5/22/29; Germany 11/13/28.

Process for the recovery of cadmium from compounds of cadmium and oxygen by distillation. C. B. von Girsewald, 1,814,023, 9/11/30; France 10/24/29.

Soldering iron. E. Jacobson, 1,814,041, 4/8/30.

Process for extracting a metal from its ore. A. Schwarz, 1,814,062, 9/19/28.

Purification of calcium. H. E. Bakken, 1,814,073, 3/10/26.

Roller type conveyer for heat treatment furnaces. R. J. Fahrenwald, 1,814,082, 1/19/29.

Centrifugal casting machine. W. H. Millspaugh, 1,814,176, 6/18/29.

Core box for ingot molds. J. E. Perry, 1,814,185, 3/28/28.

Induction heating apparatus. O. Neiss, 1,814,225, 12/5/28; Germany 12/-7/27.

Metal rolling mill screw down control. W. R. Webster, *et al.*, 1,814,354, 12/15/28.

Molding apparatus. J. T. Stoney, 1,814,416, 3/14/29 (Division of original filed 11/6/26).

Method of making electrical resistances. R. C. Benner, *et al.*, 1,814,583, 4/5/27.

Method for purifying steel. H. A. Bost, *et al.*, 1,814,584, 2/27/30.

Apparatus for controlling the shearing of moving materials. F. B. Crosby, 1,814,586, 8/1/29.

Process for widening rolled metal products. H. M. Gersman, 1,814,593, 6/21/26 (Continuation of app. filed 8/12/25).

Apparatus for widening rolled metal products. H. M. Gersman, 1,814,594. 6/21/26.

Method of preparing metal surfaces to receive permanent coatings. R. Z. Hopkins, *et al.*, 1,814,600, 12/29/28.

Method of treating ores. A. J. Koebel, 1,814,602, 3/8/28.

Ductile thorium and method of making the same. J. W. Marden, *et al.*, 1,814,-719, 6/5/24.

Preparation of ductile vanadium. J. W. Marden, *et al.*, 1,814,720, 6/6/25.

Preparation of ductile uranium. J. W. Marden, 1,814,721, 1/13/25.

Pressure distributing means for bearings. P. G. Palmgren, 1,814,734, 11/-14/25.

Rolling mill guide. P. G. Palmgren, 1,814,735 & 1,814,736, 10/17/29; Sweden 10/23/28.

Mold. E. G. Grundstrom, 1,814,797, 8/7/29.

Method and apparatus for treating slag. J. M. Hughes, *et al.*, 1,814,808, 6/3/30.

Arc welding electrode. J. M. Weed, 1,814,878, 1/13/25.

Method of soldering chains, chain-mesh or the like. G. B. Pforzheim, 1,813,-904, 3/12/28; Germany 3/17/27.

Separating volatile metals by sublimation. H. E. Bakken, 1,814,072, 1/11/26.

Process for producing metals from their oxide ores. W. E. Trent, 1,814,461, 2/28/28.

Method of and apparatus for testing metals and alloys. M. A. Miller, 1,814,-522, 1/5/29.

Core removing device. J. Hourigan, 1,814,928, 10/31/29.

Method of and means for roasting zinc blende and the like. G. Balz, 1,815,040, 10/25/28; Austria 10/31/27.

Alumino-thermic steel. J H. Deppeler, 1,815,052, 4/17/29.

Method of producing tantalum and other rare refractory metals by electrolysis of fused compounds F. H. Driggs, 1,815,054, 5/4/28.

Production of industrially valuable beryllium-bearing salts from beryllium-bearing minerals. H. Fischer, 1,815,056, 12/13/28; Germany 12/17/27.

Nonferrous alloy. (*Cu-Zn-Al-Ni.*) W. B. Price, 1,815,071, 4/16/31.

Chromium plating. E. Sohn, *et al.*, 1,815,081, 11/5/28.

Centrifugal tube-casting apparatus. I. Bignami, *et al.*, 1,815,093, 5/20/29.

Machine for bending sheet metal. R. M. Hinrich, 1,815,102, 3/17/30.

Apparatus for making pipe couplings. J. Lamond, 1,815,107, 9/12/29.

Tube expander and the like. G. Wiedeke, 1,815,174, 12/6/29.

Method of casting metals. H. L. Coles, 1,815,186, 2/20/29, renewed 1/12/31.

Safe and vault member and construction. H. L. Coles, 1,815,187, 4/24/30.

Electric soldering means. J. A. Toleik, 1,815,280, 8/1/27 (Division of application filed 1/30/26).

Bushing bearing and method of making it. J. Brincil, 1,815,344, 7/9/28.

Method for casting metals. A. W. Morris, *et al.*, 1,815,360, 2/19/29.

Apparatus for casting metal. A. W. Morris, *et al.*, 1,815,361, 11/21/29. (Division of application filed 2/19/29).

Tube piercing and expanding plug. W. Bark, 1,815,426, 12/4/29.

Plug bar for tube making machines. W. Bark, *et al.*, 1,815,427, 12/4/29.

Welding rod. F. A. Fahrenwald, 1,815,464, 1/9/29.

Zinc base alloy. (*Zn-Cu-Si.*) P. J. Morell, 1,815,479, 6/18/30.

Bright annealing of metals. R. G. Guthrie, *et al.*, 1,815,505, 11/15/29.

Rolling mill. J. J. O'Brien, 1,815,578, 8/27/29.

Hot metal mixer. L. E. Allen, 1,815,605, 6/16/28.

Process of plating metal. W. E. Watkins, 1,815,638, 5/24/29.

Furnace charging apparatus. H. D. Cook, *et al.*, 1,815,666, 11/18/30.

Method of heat treating metal. R. V. Wilson, 1,815,691, 10/31/28.

Method of and material for sealing containers. B. J. Babbitt, 1,815,695, 10/31/28.

Coiled filament and process of making it. (*Single crystal tungsten.*) F. Koref, *et al.*, 1,815,779, 6/1/22, renewed 3/23/29; Germany 7/13/21.

Die casting machine. A. S. Kipp, 1,815,776, 5/27/29.

Manufacture of finely subdivided metals. K. Marx, *et al.*, 1,815,790, 4/-14/28; Germany 7/11/27.

Rolling mill and process for rolling tubes. J. Roeder, *et al.*, 1,815,867, 6/1/28; Germany 8/20/27.

Method of producing zinc. F. R. Kemmer, 1,815,260, 6/12/29.

Method of recovering metals and oxides from boiler ash. T. F. Baily, 1,815,888, 4/2/29.

Charging bell construction. C. W. Andrews, 1,815,892, 1/20/28.

Apparatus for charging blast furnaces. A. J. Boynton, 1,815,897, 9/1/28.

Apparatus for cleaning gases. H. A. Brassert, *et al.*, 1,815,898, 1/27/28.

Method for the treatment of iron ore. H. A. Brassert, 1,815,899, 1/14/29.

Construction of hot blast stoves. H. A. Brassert, 1,815,900, 6/19/30.

Extracting of iron. A. Langer, 1,815,946, 4/6/29; Austria 4/19/28.

Portable molding machine. E. O. Beardsley, *et al.*, 1,816,000, 2/15/26; 1,816,999, 2/15/26.

Manufacture of zirconium compound refractories. G. J. Easter, 1,816,006, 5/6/29.

Refining molten metals. G. S. Evans, 1,816,007, 10/18/29.

Soldering apparatus. C. Helle, 1,816,115, 12/1/30; Germany 11/4/30.

Manufacture of iron carbonyl. A. Mittasch, 1,816,122, 2/6/26; Germany 2/9/25.

Composition for cadmium plating baths. C. H. Humphries, 1,816,152, 9/-23/27.

Blast furnace control system. R. P. Brown, 1,816,174, 4/16/28.

Flying shears. L. Johnson, 1,816,187, 4/22/26.

Method of forming resistor units. L. E. Power, 1,816,194, 6/10/27.

Welding machine. E. Riemenschneider, 1,816,231, 5/25/29.

Annealing furnace. N. G. Girshowitch, 1,816,253, 10/3/30.

Manufacture of hollow sheet metal shapes. Otto Reifurth, 1,816,298, 5/9/29; Germany 11/20/28.

Electrolytic refining of metallic aluminum. W. D. Treadwell, 1,816,304, 11/30/29; Germany 11/30/28.

Automatic feeding apparatus for sheet metal working machines. C. L. Eksergian, 1,816,319, 4/3/29.

Mold carrying conveyor. E. F. Miltenberger, 1,816,336, 2/1/30.

Method and means for forming internal flanges on tubular bodies. C. Boye, 1,816,357, 12/26/28.

Drawbench tongs. E. K. Holmes, 1,816,484, 5/24/26.

Swaging apparatus. J. A. Lewis, *et al.*, 1,816,488, 2/5/27 (Division of application filed 3/12/26).

Regenerative gas-fired open-hearth furnace. W. Schucany, 1,816,497, 8/24/26; Germany 9/1/25.

Method of treatment of non-ferrous alloys. E. M. Wise, 1,816,509, 9/3/27.

Shaping the meeting edges of curved blanks in the manufacture of sheet metal pipes and the like. W. R. Hume, 1,816,534, 6/6/28; Australia 6/27/27.

Machine for filling flasks for founding. W. F. Piper, 1,816,612, 6/7/29.

Method of galvanizing. J. L. Schueler, 1,816,617, 9/29/27.

Process for refining bismuth. W. C. Smith, *et al.*, 1,816,620, 2/6/29.

Method of producing tin. A. L. J. Queneau, 1,816,742, 1/6/28.

Permanent mold. N. J. Quinn, 1,816,744, 11/23/27.

Welded spigot and socket joint. J. Gradl, 1,816,770, 5/24/26; Germany 5/27/25.

Means for packing sand in foundry molds and cores. M. Grindal, 1,816,774, 9/10/29; Germany 10/5/28.

Prepared ingot material for use in drain opening compounds and process for making it. (*Zn-coated Al particles.*) W. C. Gangloff, 1,816,805, 6/21/28.

Checkerwork. J. P. Grilli, *et al.*, 1,815,905, 7/15/29.

Rotary casting machine. E. W. Smith, 1,816,059, 12/24/28.

Recovery of metals from ores. A. L. J. Queneau, 1,816,743, 7/26/28.

Austrian Patents

Subject of Invention, Patentee, Patent No. and Date of Beginning of Term of Patent.

Roller table for cooling beds. F. Krupp Grusonwerk Akt.-Ges., 122,910 (Addition to 105,573), 1/15/31.

Rotary melting furnace for metals and alloys. W. Buess, 122,909, 1/15/31.

Process for hardening the outer layers of cast iron. Aubert & Duval Frères, 122,931, 1/15/31.

Melting and refining cupola. P. Marx, 123,182, 1/15/31.

Alloy steel for the production of articles to be case-hardened by nitriding. F. Krupp Akt.-Ges., 122,775, 122,776 & 122,777, 8/15/28.

Process for producing low-carbon metals or alloys from their oxide ores. E. G. T. Gustafsson, 122,930, 1/15/31.

Reverberatory furnace, particularly a regenerative one. R. Warsitz, 122,934, 1/15/31.

Electric annealing furnace. Akt.-Ges. Brown, Boveri & Cie., 122,949, 1/15/31.

Two-piece chill mold for die casting. S. Junghans, 123,002, 1/15/31.

Molding device for making sand molds having undercut places. H. Hertlein, 123,186, 1/15/31.

Process for treating metals and alloys, especially copper alloys. W. Reitmeister, 122,939, 1/15/31.

Method of starting induction furnaces. J. Härdén & H. T. Tillquist, 122,936, 1/15/31.

Method and means for regulating the power factor of high-frequency induction furnaces. A. E. G. Union-Elektricitäts-Ges., 122,944, 1/15/31.

Process and apparatus for the electrolytic deposition of metals. Imperial Chemical Industries, Ltd., 122,937, 1/15/31.

Electroplating process, particularly for chromium-plating bulk goods in a rotating drum, using high-current density. Waldberg S. A., 122,952, 1/15/31.

Tank for the electrolytic deposition of metals. Imperial Chemical Industries, Ltd., 122,957, 1/15/31.

Process for the direct chromium-plating of high-carbon cast iron containing phosphorus. A. Butziger Verchromungsanlagen, 123,217, 12/15/29.

Process and apparatus for forming coatings of easily fusible metals by volatilization of the coating metal. American Machine & Foundry Co., 122,928, 1/15/31.

Process for making elongated bodies composed of a core and a closed sheath around the core. Metallges. Akt.-Ges., 122,897, 1/15/31.

Control for cutting or welding machines. Akt.-Ges. für Tiefbohrtechnik & Maschinenbau vormals Trauzl & Co., *et al.*, 122,900, 1/15/31.

Process and apparatus for arc welding with alternating current. A. E. G. Union Elektricitäts Ges., 122,917, 1/15/31.

Aluminothermically welded rail joint. Elektrothermit G. m. b. H., 122,919 & 122,920, 1/15/31.

Straightening and rolling machine. F. Ungerer, 122,906, 1/15/31.

British Patents

Note: When the date applied for differs from the date on which the application was lodged at the British Patent Office, the former date is given, followed by *.

Subject of Invention, Patentee, Patent No. and Filing Date.

Processes for heating material to medium and high temperatures with utilization of heat of condensation. E. Daub, 349,923, 11/27/29.

Joining tubes to plates. A. T. Lewis, *et al.*, 349,924, 11/28/29.

Processes and apparatus for heat-treatment of metal articles. H. Rosenberg, 349,902, 12/23/29.

Coating metallic articles with refractory material. Doherty Research Co., 350,003, 3/1/30.

Apparatus for the rapid charging of a furnace. H. Garreau, 349,918, 10/-7/29*.

Production of wires from aluminum alloys. H. Bohner, 349,978, 3/5/30.

Foundry molding machines. J. B. Neesham, 350,020, 3/8/30.

Aluminum alloy. H. C. Hall, *et al.*, 350,021 & 350,446 (Additions to 323,-353); 350,022 & 350,447 (Additions to 334,430), 3/8/30.

Lead-cable press for producing lead cables of varying sizes. Hydraulik Ges., 350,041, 4/6/29*.

Manufacture of steel. D. Colville & Sons, Ltd., *et al.*, 350,048, 3/12/30.

Chromium-plated talking-machine needles. Victor Talking Machine Co., 350,058, 3/14/30.

Electrolytic processes. Birmingham Small Arms Co., Ltd., *et al.*, 350,072, 3/18/30.

Process for the complete roasting of sulphur ores and other sulphur-containing substances. O. Saladin, 350,086, 3/21/30.

Aluminum alloy. H. C. Hall, 350,110, 4/1/30.

Recovery of molybdenum from mixtures of molybdenum or molybdenum compounds with other metals or metal compounds. I. G. Farbenindustrie Akt.-Ges., 350,135, 4/14/30.

Sheet metal blanks and method of making same. E. G. Budd Mfg. Co., 350,-245, 7/2/29*.

Fabricating and welding wide sheets of metal. E. G. Budd Mfg. Co., 350,246, 7/2/29*.

Method of treating wires and rods to be drawn with simultaneous use of trisodium phosphate lyes as neutralization means and drain oils as lubricant. R. W. Moll, *et al.*, 350,275, 11/27/29*.

Recuperative furnace constructions. Morgan Construction Co., 350,278, 7/4/30.

Welding. E. G. Budd Mfg. Co., 350,292, 8/8/29*.

Union of metal surfaces by welding. Westinghouse Lamp Co., 350,296, 7/17/29*.

Ingot molds. Valley Mould & Iron Corp., 350,302, 7/19/29*.

Apparatus for radially contracting and elongating metal cylinders. United States Pipe & Foundry Co., 350,336, 9/5/30.

Coiling metal ribbon. Griscom-Russell Co., 350,337, 10/29/29*.

Aluminium alloys and method of producing the same. Ruselite Corporation, 350,357, 4/25/30*.

Production of seamless tubes. Mannesmannröhren-Werke, 350,360, 10/5/29*.

Decomposing ores of zirconium. Deutsche Gasgluhlicht-Auerges., 350,728, 6/29/29*.

Copper-silicon-zinc alloy. Hirsch, Kupfer- und Messingwerke Akt.-Ges., 350,750, 5/27/30*.

Copper alloys. Akt.-Ges. vorm. O. Brandenburger Metallgiesserei u. Hüttenprodukte., 350,775, 7/17/29*.

Welded girders. Siemens-Schuckertwerke Akt.-Ges., 350,795, 9/11/29*.

Case-hardening furnace with charging device of worm type. H. Lindhorst, 350,812 (Addition to 330,188), 8/21/30.

Roasting and sintering pulverulent ores having a high sulphur content. Metallges. Akt.-Ges., 350,828, 9/28/29*.

Soldered connection between flat or slightly curved double walls. R. Samesreuther, 350,837, 10/8/29*.

Ingot molds. Felten & Guilleaume Carlswerk Akt.-Ges., 350,876, 12/23/29*.

Machine for welding the longitudinal seams of tapered tubes. Union Metal Mfg. Co., 350,495, 12/9/29*.

Tube manufacture. Union Metal Mfg. Co., 350,486, 12/9/29.

Proofing of iron and steel against rust. W. H. Cole, 350,420 (Addition to 289,906), 12/10/29.

Protection of iron or steel. H. Sutton, *et al.*, 350,469, 3/3/30.

Electric furnaces. British Hartford-Fairmont Syndicate, Ltd., *et al.*, 350,-474 & 350,476, 3/6/30.

Preparation of metals for use as catalysts. Soc. d'Etudes et d'Exploitation des Matierès Organiques, 350,451, 3/10/30.

Furnace tuyère grates. Erith's Engineering Co., Ltd., *et al.*, 350,530, 3/10/30.

Coated iron and steel articles and method of making the same. Parker Rust Proof Co., 350,559 & 350,560, 3/14/30 & 4/22/29.

Producing a phosphate coating on metal. Parker Rust Proof Co., 350,565, 4/29/29*.

Manufacture of ferro-nickel magnetic alloys. International Nickel Co., 350,603, 4/19/29*.

Welding rod. Stoody Co., 350,608, 4/22/30.

Process and apparatus for the reduction of pyritic ores. Patent AB. Grondal-Ramen, 350,625, 3/31/30.

Rolling processes. H. Weigel, 350,683, 5/12/30.

Process for the manufacture of steel having good machining properties. F. Borggrafe, 350,888 & 350,919, 1/10/30.

Alloy. H. Kanz, 350,889, 1/18/29*.

Rolling metal. Cold Metal Process Co., 351,079, 1/11/30*.

Machine for casting articles from molten metal. A. D. Lund, 350,905, 3/10/30.

Refractory mortars. E. Lux, 351,067, 3/25/29*.

Bars of type and like metals for feeding to the melting pots of type-casting and like machines. C. W. Hartmann, 351,103, 3/28/30.

Presser heads for apparatus for straightening sheet metal members or articles. W. Burrows, *et al.*, 350,966, 11/28/29*.

Presses for working sheet metal or the like. Marquette Tool & Mfg. Co., 351,146, 4/16/30.

Process of treating nickel-copper-bearing material. International Nickel Co., Inc., 351,150, 8/17/29*.

Electrodes for electric furnaces. Siemens Planiawerke Akt.-Ges. für Kohlefabrikate, 351,151, 8/1/29*.

Apparatus for chromium-plating small articles in quantity. E. Krause, *et al.*, 351,168, 5/5/30.

Continuous furnaces. Ugine-Infra, 351,176, 5/8/29*.

Purifying or refining non-ferrous metals or alloys. D. R. Tullis, *et al.*, 351,177, 5/8/30.

Burners for firing hot-blast stoves, furnaces, and the like, with gaseous fuel. J. E. Weyman, 351,180, 5/10/30.

Cutting tools made from sintered hard metal compositions. British Thomson-Houston Co., 351,189, 5/14/29.

Production of filaments and other bodies from rhenium. Siemens & Halske Akt.-Ges., 351,216, 6/4/30.

Method of and apparatus for upsetting the ends of tubes. Mannesmannröhren-Werke, 351,222, 3/19/30*.

Method of rolling tubes on plug rolling mills. Same patentee, 351,275, 9/13/29*.

Device suitable for use with electroplating vats, for removing sludge, small particles, and the like. G. Cooper, 351,277, 7/16/30.

Rotary kilns for burning cement, ore, etc. Vickers-Armstrong, Ltd., *et al.*, 351,283, 7/19/30.

Production of metallic magnesium from its compounds. Oesterreichische-Amerikanische-Magnesit Akt.-Ges., 351,295, 8/3/29*.

Regenerative reverberatory furnaces. O. Schweitzer, *et al.*, 351,297, 8/6/30.

Scale for determining the texture of sheet metal. A. M. Erichsen, 351,350, 10/9/29*.

Process of and apparatus for the electrolytic production of magnesium. I. G. Farbenindustrie Akt.-Ges., 351,503, 2/6/29*.

Reversing valves for regenerative furnaces. H. Crowe, 351,573, 10/18/30*.

Divided discharge channel for Martin furnaces. K. H. Moll, *et al.*, 351,506, 2/21/29*.

Protecting aluminium and aluminium alloys and/or other metals against corrosion. H. Sutton, *et al.*, 351,396, 2/22/30.

Lead alloys, more particularly for sheathings of electric cables. M. Thielers 351,449, 2/25/30.

Process and apparatus for the electrolytic production of metals, particularly magnesium. A. C. Jessup, 351,510, 2/28/30.

Guide for the mandrel rod and mandrel shaft in tube-drawing benches. Demag Akt.-Ges., *et al.*, 351,460, 2/22/30*.

Method of producing aluminum and aluminum alloys. W. Neumann, 351,524, 3/24/30.

Corrosion resisting ferrous alloy and manner of producing the same. Hall & Pickles, Ltd., *et al.*, 351,532, 3/26/30.

Method of building door arches and roofs for furnaces and the like. J. Shackleton, 351,578, 4/2/30.

Process of and apparatus for the granulation of liquid slag. Vereinigte Stahlwerke Akt.-Ges., 351,591, 4/3/30.

Storage and transportation of acetylene, more particularly for use in the autogenous working of metals. I. G. Farbenindustrie Akt.-Ges., 351,634, 4/22/30.

Reduction of metallic compounds. G. N. Kirsebom, 351,653, 5/14/29*.

Electroplating apparatus. Canning & Co., Ltd., *et al.*, 351,659, 5/9/30.

Heat treatment of cold shaped manganese steel articles. Taylor-Wharton Iron & Steel Co., 351,691, 5/23/30.

Method of shaping metallic bodies. Firth-Sterling Steel Co., 351,722, 10/-19/29*.

Method of welding. British Thomson-Houston Co., Ltd., 351,730, 6/4/29*.

Continuous copper-melting furnace. R. P. Heuer, 351,740, 6/28/30.

Apparatus for examining crystalline bodies with the aid of X-rays. N. V. Philips' Gloeilampenfabrieken, 351,744, 7/15/29.*

Method of repairing and filling up cavities, especially shrinkage holes in metal objects. Metallisator Berlin Akt.-Ges., *et al.*, 351,752, 7/7/30.

Control of motor-driven electric arc or flame cutting or welding machines. Akt.-Ges. für Tiefbohrtechnik u. Maschinenbau vorm. Trauzl & Co., *et al.*, 351,763, 7/13/29*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Manufacture of magnetic alloys. W. S. Smith, *et al.*, 312,445, 8/20/30.
Ore reduction process and apparatus. T. F. Baily, 312,447, 9/29/30
Core-molding machine. V. H. Curren, 312,471, 6/9/30.
Electric furnace. A. G. Lobley, *et al.*, 312,505, 8/8/29.
Sand milling apparatus. The Beardsley & Piper Co., 312,552, 12/1/30.
Spoke welding method and apparatus. The Budd Wheel Co., 312,557, 1/6/30.
Welding method. The Budd Wheel Co., 312,558, 4/3/30.
Process of carburizing and hardening metal articles. Deutsche Gold & Silberscheideanstalt vormals Roessler, 312,854, 7/21/30.
Metal-working blowpipe. The Dominion Oxygen Co., Ltd., 312,585, 5/-25/29.
Blowpipe. The Dominion Oxygen Co., Ltd., 321,586, 6/7/29.
Press for metal tubes or sheathings. Felten & Guilleaume Carlswerk Akt.-Ges., 312,590, 10/13/30.
Metal purification process. Kaiser-Wilhelm Institut für Eisenforschung, 312,608, 1/22/27.
Liquid fuel torch. Cutting & Welding Torch Corp., 312,616, 3/27/30.
Process for forging alloys having a magnesium base. La Soc. "Le Magnesium Industriel," 312,617, 3/26/28.
Wire drawing apparatus. The Morgan Construction Co., 312,627, 1/16/30.
Heat treatment of cold shaped manganese steel articles. The Taylor-Wharton Iron & Steel Co., 312,650, 5/12/30.
Billet & bloom grooving machine. L. C. Reis, 312,676, 8/13/30.
Electric arc welding method. J. C. Lincoln, 312,726, 12/18/29.
Method of electrically welding pipes. C. M. Thomson, 312,479, 1/22/30.
Casting machine for brake shoes. J. D. Travis, 312,751, 6/26/29.
Parting facing product for casting metals. B. F. Wallace, 312,754, 5/3/30.
Tube & rod forming machine. The American Fork & Hoe Co., 312,762, 8/16/29.
Blast furnace gas cleaning apparatus. H. A. Brassert & Co., 312,771, 10/-29/28.
Water cooled welding cable joint. The Edward G. Budd Mfg. Co., 312,776, 4/9/30.
Welding electrode. Same patentee, 312,779, 6/27/30.
Guide mechanism for welding machines. Same patentee, 312,780, 9/5/30.
Rotary furnace. The Canadian Westinghouse Co., Ltd., 312,786 & 312,787, 5/20/27.
Electric welding apparatus. Same patentee, 312,790, 8/4/30.
Pressure welding electrode. The Fansteel Products Co., Inc., 312,808, 1/17/30.
Process of producing articles made of magnesium-manganese alloys. I. G. Farbenindustrie Akt.-Ges., 312,815, 8/1/30.
Bearing metal. (*Pb-Ca-Sn-Hg-etc.*) The S & T Metal Co., 312,855, 5/-31/29.
Method of electrically welding tubular articles. The A. O. Smith Corp., 312,-861, 4/11/30.
Manufacture of electrically welded pipes. The A. O. Smith Corp., 312,862, 4/14/30.
Weldrod for electric arc welding. The A. O. Smith Corp., 312,863, 4/22/30.
Ingot mold. The Valley Mould & Iron Corp., 312,880, 7/2/30.
Method and apparatus for casting metals. The Wetherill-Morris Engineering Co., 312,885, 12/16/29.
Method and apparatus for electric welding. The Youngstown Sheet & Tube Co., 312,894, 5/7/29.
Process for recovery of base metals and salts from ores. E. A. Ashcroft, 312,928, 4/2/29.
Electric furnace charging apparatus. P. L. J. Miguet, 312,968, 3/22/29.
Welding machine. The Edward G. Budd Mfg. Co., 313,025, 7/4/30.
Metal reduction bomb. The Canadian Westinghouse Co., Ltd., 313,030, 12/29/28.
Method of carbonizing metals and alloys. Same patentee, 313,031, 12/31/28.
Production of metals from metal halides. I. G. Farbenindustrie Akt.-Ges., 313,056, 4/7/30.
Method of making steel abrasive materials. The Globe Steel Abrasive Co., 313,059, 2/10/30.
Apparatus for feeding wires through furnaces. The Niagara Wire Weaving Co., Ltd., 313,087, 2/10/30.
Aluminum alloy. (*Al-Cu-Cr-Mo-Ti.*) The Ruselite Corp., 313,104, 5/-12/30.
Process of manufacturing metallic beryllium or its alloys. Siemens & Halske Akt.-Ges., 313,109, 10/3/27.
Metal sheet rolling apparatus. The Wean Engineering Co., Inc., 313,121, 8/2/30.
Manufacture of elongated tubular articles (cast metal tubes). R. S. Waters, 313,138, 1/8/30.
Process of reducing tin, etc. E. A. Ashcroft, *et al.*, 313,413, 1/30/30.
Process of producing pure aluminum compounds (for production of aluminum metal). M. Buchner, 313,157, 2/27/29.
Device for refining and purifying metals. F. W. Corsalli, 313,161. 7/25/27.
Sintering machine. C. H. Mace, 313,196, 6/11/30.
Pack handling apparatus. The American Sheet & Tin Plate Co., 313,232 & 313,233, 1/10/30.
Hot mill catcher. Same patentee, 313,234, 1/28/31.
Production of finely divided metals. I. G. Farbenindustrie Akt.-Ges., 313,266, 4/8/30.
Continuous sheet steel normalizing furnace. F. A. Fahrenwald, 313,343, 4/12/30.
Tuyère. O. P. Wright, 313,344, 9/13/30.

Danish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for coating metallic bodies with tungsten or molybdenum "bronzes." Egyesült Izzolampa és Villamossági Részvénytársaság, 44,053, 7/21/30.
Process and apparatus for treating, particularly for coating the inner walls of hollow objects. H. J. Prins, 44,062, 1/10/30.
Magnetic material. Standard Electric A/S., 44,137, 10/4/26.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Rolling mill with grooved rolls. F. Moller, 707,613, 12/16/30.
Process for agglomerating and briquetting blast-furnace throat dust. A. Lang, 707,676, 12/6/30.
Improvements to metallic alloys. The Kinzokuzairyo Kankyujo, 707,693, 12/11/30.
Ingot turner. J. P. Kieffer, 707,967, 12/18/30.
Process and machine for filling molds and core boxes with sand. F. Rolff, 707,606, 12/16/30.
Improved process and machine for forging or stamping. Ford Motor Co., Ltd., 707,623, 11/17/30.
Process for casting metals. G. Pemetzrieder, 707,634, 11/20/30.
Machine for cleaning sheet metal prior to electric resistance-welding. P. Sourdis, 707,746, 3/20/30.
Automatic circuit breaker for metering energy supplied to an electric resistance-welding machine. S. A. des Anciens Etablissements Achard & Co., 707,940, 12/18/30.
Device for taking samples from billets, ingots, etc. United States Metals Refining Co., 707,703, 12/12/30.
Improvements to instruments for indicating temperature. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 707,937, 12/18/30.
Electrode furnaces controlled by means of a compressed fluid. S. A. Brown, Boveri & Cie., 707,595, 12/16/30.
Process for forming coatings by cathodic sputtering. M. Knoll, 707,671, 12/4/30.
Electrodes for electric furnaces. Cie. des Forges et Aciéries de la Marine et d'Homécourt, 707,729, 3/19/30.
New process for stamping plates for distillation and rectifying columns. J. B. J. Vidal, *et al.*, 707,769, 3/24/30.
Process and means for recuperation of heat in industrial thermal apparatus. Chaudronneries A. F. Smulders, 707,833, 12/15/30.
Improvements to conveyors for furnaces, etc. A. Smallwood, *et al.*, 707,851, 12/15/30.
Improvements to electric heating elements and to process for making them. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, Addition 38,754 (9th addition to 535,632 filed 5/18/21), 5/14/30.
Conveyor for sheet metal. Copperized Steel Ltd., 708,397, 12/26/30.
Improvements in the rolling of disks. Budd Wheel Co., 708,020, 12/11/30.
New light alloy. The Birmingham Aluminium Casting (1903) Co., Ltd., 708,178, 12/20/30.
Nitrided steel and process for making it. W. Kroll, 708,194, 12/22/30.
Process for making molybdenum carbonyl. I. G. Farbenindustrie Akt.-Ges., 708,379, 12/26/30.
Process for making finned tubing. A./S. per Kure Norsk Motor & Dynamofabrik, 708,005, 11/24/30.
Improvements to materials for facing sand molds for casting metals. B. F. Wallace, 708,018, 12/9/30.
Improvements to chill molds for casting pistons for internal combustion engines. The Borgo Piston Co., 708,041, 12/19/30.
Improvements in the fabrication of forged chains. Etablissements Doremieux Fils & Cie. E. Quinet, 708,067, 3/25/30.
Machine and installation for pickling. R. Joessel, *et al.*, 708,133, 4/2/30.
Improved plug for chill molds for casting pistons for internal combustion engines. The Borgo Piston Co., 708,183, 12/20/30.
Utilization of scrap metal of any nature. P. Selve, 708,243, 12/23/30.
Process for making porous or non-porous metal objects. I. G. Farbenindustrie Akt.-Ges., 708,259, 12/23/30.
Process for preventing the formation of "white rust" on zinc. Vereinigte Stahlwerke Akt.-Ges., 708,346, 12/24/30.
Improvements to vertical presses having a pivoting punch. Cie. Française des Métaux, 708,390, 12/26/30.
Improvements to the process and to the machine for making lead pipe. R. E. Roberts, 708,416, 12/27/30.
Electric welding machine. H. A. Schlatter, 708,417, 12/27/30.
Material for forming molds and cores for sand molds. O. Elmqvist, 708,455, 12/29/30.
Registering microdilatometer suitable for studying the transformations in alloys. S. A. de Commentry, Fourchambault & Decazeville, 708,109, 3/29/30.
Improvements in the fabrication of metal sheet, strip or wire. S. O. Cowper Coles, *et al.*, 708,420, 12/11/30.
Apparatus for the electrolytic deposition of metals. S. A. Waldberg, Addition 38,801 (1st addition to 702,855 filed 12/27/29), 4/8/30.
Process for the production of carbonyl compounds of molybdenum and tungsten. I. G. Farbenindustrie Akt.-Ges., 708,260, 12/23/30.
Improvements to methods of guiding machine tools using a template. Soc. la Soudure Autogène Française, 708,671, 4/3/30.
Improvements to machines and process for casting under pressure in metal molds. C. Pack, 708,754, 12/31/30.
Process for the production of metallic tungsten. I. G. Farbenindustrie Akt.-Ges., 708,595, 12/30/30.
Steel for making high-strength structural elements. Vereinigte Stahlwerke Akt.-Ges., 708,758, 12/31/30.
Improvements to alloys of aluminum and silicon. Aluminium Ltd., 708,848, 1/5/31.
Steel having a high elastic limit. Vereinigte Stahlwerke Akt.-Ges., 708,971, 1/8/31.
Process for making laminated metals by centrifugal casting. G. Pemetzrider, 708,578, 12/30/30.
Improvements to welded chains. Soc. La Soudure Autogène Française, 708, 961, 4/5/30.
Improvements to foundry molds and cores. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 708,798, 1/3/31.
Process for the simultaneous heat treatment of metal objects in several different localities. "Schmiedag" Vereinigte Gesenkschmieden Akt.-Ges., 708, 849, 1/5/31.
Method of making microscopical specimens for observing the surfaces of substances. Gunze Seishi Kabushiki Kaisha, 708,813, 1/3/31.
Improvements in electroforming. General Motors (France), 708,469, 10/6/30.
Process for recovering pure metals from alloys or metallic mixtures. Vatea Radiotechnische & Elektricitäts Akt.-Ges., 708,551, 12/29/30.
Controllable resistance heating element for electric heat-treating furnaces. E. F Russ, 708,843, 1/5/31.
Electrolytic process for cleaning wire, strip, etc. F. A. Herrmann, 708,954, 1/8/31.
Heat treating furnace. Poetter G. m. b. H., 708,486, 11/18/30.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Strip rolling mill. Engelhardt Achenbach sel. Söhne G. m. b. H., 527,389, 10/6/27.

Return guide for the rolled material passing between two adjacent roll stands. E. Behr, 527,390, 9/17/29.

Means for suspending the upper roll of rolling mills. A. Herrmann, 527,596, 11/20/29.

Roller bed with two or more adjacent runways for the rolled material. F. Krupp Grusonwerk Akt.-Ges., 527,761, 12/16/25.

Means for welding tubing. P. Schmatz, 527,610, 1/8/29.

Process for making pipes by helically winding a strip of sheet metal. California Corrugated Culvert Co., 527,391, 2/8/28.

Process for cold-squirting aluminum tubing. Süddeutsche Metallindustrie, 527,611, 11/23/28.

Process for making knives and forks. W. Stolz, 527,392, 6/13/30.

Decomposing ores containing titanium or niobium. I. G. Farbenindustrie Akt.-Ges., 527,615, 7/27/28.

Process for sintering dusty ores and metallurgical products. Vereinigte Stahlwerke Akt.-Ges., 527,773 (Addition to 472,916), 11/17/29.

Tap-hole plugging machine. E. Schiegries, 527,623, 2/4/30; 529,408, 2/-6/30.

Method of operating an electric steel furnace plant comprising two furnaces of different capacities. H. Röchling & W. Rodenhauser, 527,763, 1/17/26.

Process for removing a metallic deposit. Radio-Röhren Laboratorium Dr. Nickel G. m. b. H., 527,491, 9/10/24.

Electric resistance furnace whose resistance elements are held in bushings, Porzellanfabrik Ph. Rosenthal & Co. Akt.-Ges., 527,727, 11/29/28.

Method of controlling the motion of metal baths in ironless induction furnaces, Hirsch, Kupfer und Messingwerke Akt.-Ges., 527,452, 2/25/28.

Cupola forehearth. F. Schinke, 527,455, 7/31/29.

Cylindrical rotary drum furnace for melting metals and alloys. Badische Maschinenfabrik & Eisengiesserei vorm. G. Sebold u. Sebold & Neff. 527,732 (Addition to 520,174), 4/8/27.

Method and heating device for drying foundry molds. Allgemeine Elektricitäts Gesellschaft, 527,408, 9/26/30.

Device for preventing burning accidents at the interchangeable tuyères of shaft melting furnaces. R. Stotz, 527,571, 7/24/30.

Core binder. A. Stahn, 527,530, 1/12/28.

Process for making iron castings by the centrifugal method. Cie. Générale des Conduites d'Eau, 527,531, 11/13/24.

Shaking device with sieve frames, especially for foundries. V. J. Davis, 527,-572, 9/6/29.

Device for cleaning castings, using a freely movable jet of water. Badische Maschinenfabrik & Eisengiesserei vormals G. Sebold u. Sebold & Neff., 527,802 (Addition to 523,342), 2/25/27; 529,053, 4/15/27.

Production of solid lumps of metallic arsenic. W. Schärfe, 527,807, 12/23/28.

Crucible composed of conducting material, preferably graphite, to be used as bath container and as anode in fusion electrolysis. Siemens & Halske Akt.-Ges., 527,411, 3/15/29.

Process for the electrolytic deposition of heavy metals. M. Schlötter, 527,739, 11/10/28.

Process for making optical metal mirrors having high reflectivity. I. G. Farbenindustrie Akt.-Ges., 527,578, 4/28/29.

Bearing. E. Fitscher G. m. b. H., 527,744, 2/19/30.

Process for coating the inner walls of hollow sheet metal bodies with a rust-preventing metal. F. E. Krauss, 527,653, 5/29/30.

Machine for cutting moving material. Steel & Tubes, Inc., 527,424, 6/10/28; U. S. 6/10/27 & 4/21/28.

Machine for making bronze powder. Hartstoff-Metall Akt.-Ges. (Hametag), 527,536, 2/12/30.

Rolling mill having means for adjusting the pass. Engelhardt Achenbach sel. Söhne G. m. b. H., 527,856, 10/12/27.

Roller bed with individually electrically driven rollers. F. Krupp Grusonwerk Akt.-Ges., 528,036 (Addition to 512,123), 7/13/29.

Means for suspending the roof lining blocks of metallurgical melting furnaces. Wild-Barfield Electric Furnaces, Ltd., 528,276, 2/22/29; Great Britain 11/21/28.

Induction furnace for melting, annealing, hardening, etc. C. Lorenz Akt.-Ges., 527,946, 10/26/28.

Blast ducts for cupolas. F. Schinke, 528,066, 9/18/30.

Water-soluble core binder. A. Stahn, 528,172, 3/26/29.

Guide bolts for molding flasks. W. Stock, sen., 528,173, 9/6/29.

Process for making iron rolls. Gewerkschaft Kronprinz, 528,174 (Addition to 506,194), 4/17/30.

Process for improving a bearing metal alloy in which graphite or a similar ingredient is embedded. H. Borofski, 528,127, 1/4/27.

Process for corrosion-proofing aluminum-magnesium alloys containing about 10% magnesium. K. Schmidt, G. m. b. H., 528,025, 1/8/25.

Instrument for determining the change in length of test specimens. A. J. Amsler, 527,893, 3/24/29.

Electrolytic process for making anodes for electrolytic nickel-plating. Sächsische Blaufarbenwerke Verein, 527,827, 4/15/27.

Process for coating hollow surgical needles with chromium. Hessmer & Wercker, 527,903, 2/23/29.

Machine for dividing ingots. Hydraulik G. m. b. H., 527,988, 12/17/29.

Mounting for the table rollers of blooming and plate mills. Schloemann Akt.-Ges., 528,811, 8/19/30.

Method of removing the end of the billet from extrusion presses. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 528,671, 10/14/28.

Extrusion press for tubing. Hydraulik G. m. b. H., *et al.*, 528,672, 7/25/29.

Lead-cable press for making cables of different diameters. W. T. Henley's Telegraph Works Co., Ltd., 528,673, 4/12/29; Great Britain 6/28/28.

Process for manufacturing pipe connections. O. Reifurth, 528,674 (Addition to 495,952), 1/8/30.

Process for making corrugated sheets with accurately spaced corrugations. H. Syrowy, 528,487, 5/19/29.

Method of changing the shape of a hollow body by application of hydraulic pressure. United States Cast Iron Pipe & Foundry Co., 528,488, 6/26/29; U. S. 12/29/28.

Process for making very pure iron powder. I. G. Farbenindustrie Akt.-Ges., 528,463, 9/11/27.

Sand trough for sealing the throat closure against the shaft of blast furnaces. Kölsch-Fölzer-Werke Akt.-Ges., 528,828, 7/6/30.

Process for reducing iron ore with gases. I. G. Farbenindustrie Akt.-Ges., 528,346, 4/12/25.

Process for producing iron from ores, slag or other ferrous materials. E. Diepschlag, 528,678 (Addition to 470,015), 7/20/29.

Hand lever for opening and closing the doors of metallurgical furnaces. F. Krupp Akt.-Ges., 528,745, 7/23/30.

Auxiliary nickel alloy containing carbon and silicon, for the production of iron alloys containing nickel. The International Nickel Co., Inc., 528,746, 9/10/26.

Conductor for the coils of induction furnaces. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 528,690, 2/28/30.

High-frequency induction furnace for heating and melting charges of large transverse dimensions and small height. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 528,800, 7/18/29; U. S. 8/2/28.

Electric spot-welding machine. Edward G. Budd Mfg. Co., 528,605 (Addition to 499,349), 8/8/26; U. S. 8/15/25.

Device for blowing out foundry molds. W. Schwarz, 528,663, 12/20/29.

Process and device for making foundry molds. E. Moussiaux, 528,389, 5/-31/29.

Device for blowing out foundry molds with compressed air. W. Schwarz, 528,802, 12/20/29.

Die casting process and means for working it, using a low-pressure and a high-pressure blower. P. Mabieu, 528,388, 1/14/30, 12/7/29.

Process and means for improving and refining molten metals and alloys by shaking. F. W. Corsalli, 528,390 (Addition to 459,299), 7/1/26.

Device for refining or degasifying molten metals, especially iron, by jolting. C. Dechesne, 528,756 (Addition to 521,528), 6/20/25.

Removable partition for chill molds for compound casting. Vereinigte Stahlwerke Akt.-Ges., 528,524, 6/23/29.

Centrifugal casting mold for making annular castings. W. Bremicker, 528,391, 3/24/29.

Casting machine, using a centrifugal plate rotating in a stationary housing. G. Pemetzrieder, 528,392 (Addition to 525,225), 6/11/30.

Pouring trough, particularly for filling centrifugal casting molds. Cie. Générale des Conduites d'Eau, 528,525, 3/6/29; Belgium 3/6/28.

Process for annealing metal strip. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 528,615, 4/16/29.

Process for coating non-conducting objects with metallic coatings. U. Gottesmann, 528,766, 10/15/29.

Metal-cleaning and degreasing installation. M. Heller, 528,624, 2/8/30.

Adjusting device for roll housings. Schloemann Akt.-Ges., 529,128, 6/26/30.

Control valve for hydraulic presses. F. Krupp Grusonwerk Akt.-Ges., 528,889, 2/15/29.

Disk-rolling machine. Budd Wheel Co., 529,061 (Addition to 504,111), 5/14/25; U. S. 4/9/25.

Process for producing sponge iron from iron ores. F. Krupp Akt.-Ges., 529,-136, 10/12/28.

Process for preparing scrap metal for melting in electric furnaces, by removing the adhering oil. The Timken Roller Bearing Co., 529,074, 10/9/29.

Vertical electric bright-annealing furnace. Heraeus-Vacuumschmelze-Akt.-Ges., 529,194 (Addition to 480,691), 12/16/24.

Process for making magnetic materials having high permeability. Siemens & Halske Akt.-Ges., 529,241, 1/17/28.

Means for heating conducting crucibles, or metals in non-conducting crucibles by means of alternating current of any desired frequency. K. Fischer, 528,837, 3/4/30.

Method of cooling the inductor windings of electric induction furnaces. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 529,243, 7/13/30; U. S. 7/13/29.

Metal-armored, continuous carbon electrode for electric furnaces. J. Rees, 529,118, 6/6/25.

Process for making self-baking continuous electrodes. Det Norske A/S for Elektrokemisk Industri, 529,244, 9/27/28.

Scraper having two mutually insulated blades, for the welding-roller grooves o tube-welding machines. F. Stiehl, 529,119, 2/5/30.

Method of controlling the flame length in the hearth chambers of regenerative furnaces. H. Passauer, 529,144, 2/16/29.

Flask pins. L. F. Komm.-Ges., 529,153, 11/2/30.

Channel stone for conducting molten metal. Krämer & Co., 529,154, 2/22/30.

Process for the simultaneous production of two or more castings by the centrifugal method. G. Pemetzrieder, 528,881, 12/4/29.

Invar mold for casting pure metals or alloys, especially zinc and aluminum alloys. Felten & Guilleaume Carlswerk Akt.-Ges., 528,841, 12/24/29.

Process and mold for casting metals and alloys. Heraeus Vacuumschmelze Akt.-Ges., 528,882, 12/2/27.

Process for joining a metal object to a more refractory metal. Metallges. Akt.-Ges., *et al.*, 529,052, 6/23/25.

Process for making metal packing rings in one or several pieces. F. Bering, 529,253, 6/26/29.

Preparation of slimy ores for blast-roasting, and blast-roasting apparatus. Metallges. Akt.-Ges., 528,846, 6/29/29.

Production of volatilizable metals from ores, metallurgical products and residues of all kinds. F. Krupp Grusonwerk Akt.-Ges., 529,028 (Addition to 473,016), 11/6/25.

Production of metallic magnesium by reduction of magnesium compounds with carbon in the electric arc. Oesterreichische-Amerikanische-Magnesit Akt.-Ges., 529,160, 8/18/29; Austria 8/3/29.

Removal of zinc from metals and alloys, particularly from type metal. F Schweitzer, 528,927, 1/25/29.

Process for making goods similar to doublé wares. E. G. Bek, 528,885, 12/-12/24.

Process and device for making doublé and sheathed wires. Fr. Kammerer Akt.-Ges., 529,033, 4/6/30.

Roller bed or table particularly for rolling mills. F. Krupp Grusonwerk Akt.-Ges., 529,614, 2/22/30.

Welding machine for pipe elements. Vereinigte Stahlwerke Akt.-Ges., 529,-534, 4/12/28.

Process for making knife blades. Klöckner Werke Akt.-Ges., 529,799, 5/-26/29.

Method of protecting devices made of copper and copper alloys against corrosion by carboxylic acids. Soc. Chimique des Usines du Rhone, 529,693, 2/5/27.

High-frequency induction furnace. Siemens & Halske Akt.-Ges., 529,394 (Addition to 507,556), 12/9/27.

Means for regulating electric arc furnaces. Allgemeine Elektricitäts Ges., 529,307, 2/18/28.

Method of heating metal rings. Siemens-Schuckertwerke Akt.-Ges., 529,694, 8/24/26.

Process and means for making bimetallic ingots. Metallges. Akt.-Ges., 529,-350, 5/12/29.

Casting process for aluminum alloys. V. Fuss, 529,468, 5/18/29.

Device for loosening and moving the bottom plate of chill molds. Heraeus Vacuumschmelze Akt.-Ges. & W. Rohn, 529,496, 10/13/29.

Norwegian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Electric furnace. E. Bornand & H. A. Schlaepfer, 49,293, 11/19/28.

Electric furnace. A/S Moss Glasvaerk, 49,294, 12/31/28.

Process and machine for the centrifugal casting of metal ingots in rotating vertical chill molds. Mannesmannröhren-Werke Akt.-Ges., 49,297, 8/25/28.

Process for casting magnesium and its alloys in sand molds. I. G. Farbenindustrie Akt.-Ges., 49,298, 7/30/29.

Welding magnesium and its alloys. Same patentee, 49,305, 3/22/30.

Process for making welding wire. Vereinigte Stahlwerke Akt.-Ges., 49,329, 8/5/30.

Process and device for melting easily fusible alloys. C. Brackelsberg, 49,369, 11/6/29.

Fusion electrolysis process. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 49,373, 7/11/29.

Swedish Patents

Subject of Invention, Patentee, Patent No. and Filing Date:

Apparatus for the electrolytic production of light metals. Ges. für Chemische Industrie in Basel, 72,308, 7/22/30; Priority Dates 8/23/29 & 8/29/29.

Draw bench for hot-drawing seamless tubing. Rheinische-Metallwaaren u. Maschinenfabrik, 72,333, 7/29/30.

Die-casting machine. J. Polak, 72,348, 5/16/27.

Process for welding magnesium and magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 72,359, 4/29/29; Priority Date 6/12/28.

Process for producing pure iron. H. J. van Royen, 72,375, 12/6/27; Priority Dates 12/14/26 & 12/15/26.

Electric induction furnace not having an iron core. Allmänna Svenska Elektriska AB, 72,384, 11/30/28.

Protective device for electric furnaces. L. W. Wild, *et al.*, 72,385, 9/13/29; Priority Date 3/20/29.

White metal alloy. C. Philippossian, 72,395, 11/2/29; Priority Date 11/-3/28.

Process for soldering metal parts. N. V. Philips Gloeilampenfabrieken, 72,-408, 2/26/30; Priority Date 4/27/29.

Welding burner for highly explosive gas mixtures. "L'Air Liquide" S. A., 72,421, 1/20/30; Priority Date 2/8/29.

Process for producing metals. E. A. A. Grönwall, *et al.*, 72,433, 5/23/28.

Method of casting pipes in rotating molds. Sand Spun Patents Corp., 72,447, 9/2/25.

Device for stripping hollow patterns or castings from sand molds. C. B. Pike, 72,448, 12/28/28.

Cooling means for bright-annealing furnaces. Siemens-Schuckertwerke Akt.-Ges., 72,542, 11/5/28; Priority Date 3/26/28.

Electric annealing furnace. Same patentee, 72,555, 4/8/27; Priority Date 5/3/26.

Regulating device for inductive heating elements. H. Bollmann, *et al.*, 72,556, 11/22/28; Priority Date 12/7/27.

Swiss Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Tilting furnace. Siemens & Halske Akt.-Ges., 145,737, 1/8/30; Germany 1/19/29.

Joining electric furnace electrodes. Siemens Planiawerke Akt.-Ges. für Kohlefabrikate, 145,787, 4/11/30; Germany 8/1/29.

Process for producing aluminum. A. Pacz, 146,044, 12/31/28; Germany 1/7/28.

Process and machine for making welded tubing, especially precision tubing. Ges. der Ludw. v. Roll'schen Eisenwerke, 146,047, 1/25/30; Austria 2/1/29.

Device for hardening the flanks of screw and worm threads. F. Klopp, 146,049, 3/4/30.

Method and device for hardening moldboards for ploughs. Gebr. Ott, 146,050, 4/11/30.

Pipe-cutting burner. Carba Akt.-Ges., 146,110, 3/11/30.

Process for refining metals and alloys by the thermal method. Siemens & Halske Akt.-Ges., 146,311, 12/23/29; Czechoslovakia 12/27/28.

Foundry mold and process for making it. J. Durand, 146,312, 12/21/29; France 9/29/28.

Method and means for operating several equalized-pressure welding burners. F. Mangiameli, 146,313, 2/21/30.

Process and machine for making hollow bodies by welding together the two parts thereof. Budd Wheel Co., 146,314, 1/23/30; U. S. 1/26/29.

Process for making straight-walled pipe. G. A. Ferrand, 146,315, 1/2/30; France 2/1/29.

Process for making constructional elements which are to be highly stressed. Vereinigte Stahlwerke Akt.-Ges., 146,318, 3/22/30; Germany 5/17/29.

Process for bright-annealing metal objects, with exclusion of air. Akt.-Ges. Brown, Boveri & Cie., 146,319, 4/10/30; Germany 4/25/29.

Means for cooling metals under approximately constant pressure. Siemens-Schuckertwerke Akt.-Ges., 146,450 (Addition to 140,184), 8/1/29; Germany 11/15/28.

Process for protecting aluminum and its alloys against corrosion. Soc. Continentale Parker, 146,565, 11/9/29; France 11/10/28.

Process for forming an oxide layer on aluminum or aluminum alloy wires for coils. R. E. Müller, 146,566, 5/7/30; Germany 5/8/29.

Corrosion- and fire-resistant alloy steel. T. Czepl, 146,613, 6/17/30; Germany 2/6/30.

Process for making casting of an aluminum alloy having a considerable silicon content. Aluminium Industrie Akt.-Ges., 146,614, 3/11/30.

Process for producing metals by electrolysis of halide salt melts. I. G. Farbenindustrie Akt.-Ges., 146,615, 10/8/29; Germany 11/22/28, 4/26/29 & 5/1/29.

Molding machines. G. Zimmermann, 146,616, 3/10/30; Germany 3/14/29.

Jolting table. Boggild & Jacobsen, 146,617, 8/14/29; Germany 9/7/28.

Process for making castings of magnesium and magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 146,618, 11/20/29; Great Britain 12/19/28.

Two-piece die casting mold. S. Junghans, 146,619, 4/26/30.

Process for preparing coated objects, such as welding rods, electrodes, etc. La Soudure Electrique Autogène S. A., 146,620, 1/7/29; France 1/26/28.

Process for welding magnesium and its alloys. I. G. Farbenindustrie Akt.-Ges., 146,621, 3/17/30; Germany 4/26/29 & 12/14/29.

Process for welding by electric induction. E. Bornand & H. A. Schlaepfer, 146,622, 9/13/30.

Process and extrusion press for working difficultly deformable metals. P. Multhaupt, 146,623, 7/1/29; Germany 12/21/28.

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

901 **Core Ovens.**—Bulletin No. 32 of the Foundry Equipment Company, Cleveland, Ohio, is devoted to their continuous conveyor core ovens. It shows a number of installations with complete descriptions, layouts and illustrations.

902 **Laboratory Furnaces.**—Catalog No. 30 of the Hevi Duty Electric Company, Milwaukee, Wisconsin, illustrates a number of their furnaces for laboratory and tool room use. They can supply almost any type of furnace or hotplate needed, including special furnaces for processes requiring higher temperatures than usual.

903 **The Brackelsberg Furnace.**—This German furnace was introduced to American foundries by the Whiting Corporation, Harvey, Ill., because they believe that it produces gray iron of higher quality than is usually obtained from present methods of manufacture. They have prepared a pamphlet which gives in great detail the physical properties of gray iron produced in the furnace, showing micrographs and giving numerous tables.

904 **Electric Furnaces.**—The Hayes "Certain Curtain" electric furnace was developed in 1926 to fill the demand for a positive furnace atmosphere control. It is designed for heat treating at temperatures between 1850 and 2500° F. A pamphlet which describes the new principle of atmosphere control which is embodied in this furnace can be obtained from the C. I. Hayes, Inc., 129 Baker Street, Providence, R. I.

905 **Silver Solder.**—The "Handy Book of Silver Solder" has been compiled by Handy & Harman, 57 William St., New York, N. Y., to present the results of tests the company has been making for the past five years. They have created a number of standard compositions which are listed in this book together with their description and prices. The same company has also issued two bulletins—No. 1, entitled "How to Use Handy Silver Solders" and No. 2 which describes their refining headquarters.

906 **Cutting Metals.**—Ramet—tantalum carbide—closely approaches the diamond in hardness, has a tensile strength of 250,000 lbs./in.^{2} and withstands shock and impact remarkably well and can be ground to a fine cutting edge. The Fansteel Products Company, North Chicago, Illinois, has issued an attractive leaflet describing this product which is offered in a wide range of styles and sizes which will be found adaptable to most turning operations.

907 **Heat Treating Furnaces.**—Bulletin No. O-3 of the Ryan, Scully & Co., Philadelphia, Pa., describes a type of oil-fired heat treating furnace which meets industrial requirements and contains unusual features with reference to rugged construction, ease of operation, control of temperature and over-all low cost of upkeep. Their bulletin No. 11 describes their portable box type high temperature electric heating furnaces for heat treating, forming, forging, etc. Bulletin No. 14 discusses their electric tempering baths for oil or salt bath mixtures.

908 **Ovens.**—Catalog No. 100 of Lydon Bros., Jersey City, N. J., lists and describes their various types of ovens, from the small laboratory oven which is electrically heated to the large gas-fired tunnel type. The catalog is well-illustrated and attractively gotten up.

909 **Nitriding.**—The Hevi Duty Electric Co., Milwaukee, Wis., has sent out their bulletin 830 which is entitled "Essentials of Successful Nitriding." It describes the process and equipment.

910 **Hardening of Steel.**—The Hump method of hardening of steel is outlined in Catalog No. 90 of the Leeds & Northrup Co., Philadelphia, Pa. In this method the hardener can see directly when the critical point of the actual tool or piece is reached, the quenching point is charted definitely above the critical, the method is more accurate than former methods, and tools or parts hardened by this method are longer-lived. The same company publishes a leaflet describing an instance where the Hump method was used and the results obtained.

911 **Stainless and Heat Resisting Steels.**—The Subsidiary Manufacturing Companies of the United States Steel Corporation are producing a comprehensive line of stainless and heat resisting steels, now available in the form of finished and semi-finished products. These alloys are all of the relatively low carbon type and may be broadly classified under two main headings: Chromium alloy steels; Chromium-nickel alloy steels. The corporation has issued a 35-page booklet describing them.

912 **Special Furnaces.**—The Surface Combustion Corporation, Toledo, Ohio, has prepared a series of leaflets discussing a number of installations of their furnaces. Each of these is a special furnace designed and built by the company. The installation is illustrated in each case and operating data are given.

913 **Furnaces for Treating Steel.**—Catalog No. 4 of the Bellevue Industrial Furnace Co., Detroit, Mich., lists and illustrates stock sizes of their furnaces and accessories designed to supply standard equipment for all methods of metal heat-treating. They are adapted for oil or for gas, or to meet individual conditions or preferences. This is an 88-page catalog and is profusely illustrated.

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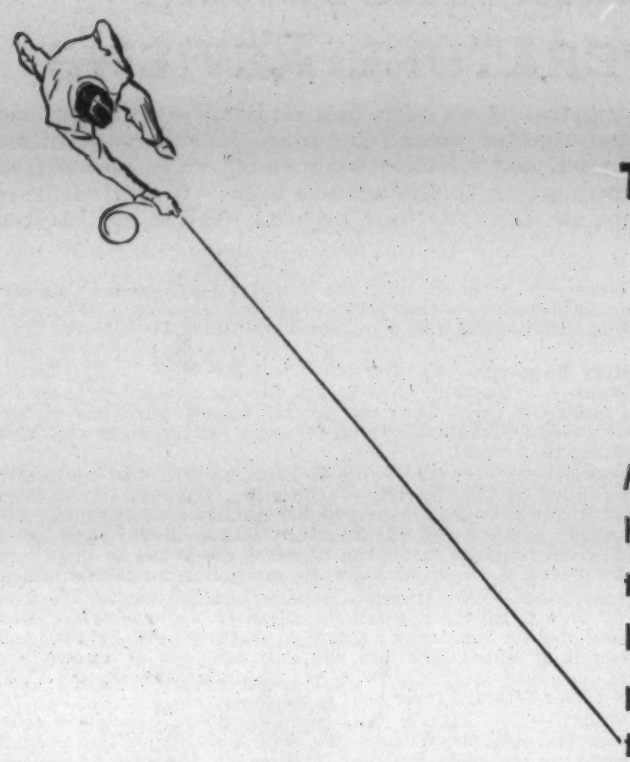

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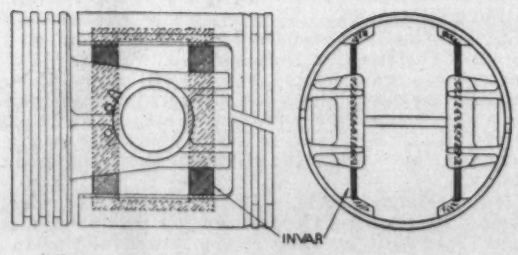

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METALLURGICAL ABSTRACTS, incorporated in METALS & ALLOYS, is the most complete review of metallurgical literature (periodicals, books, etc.) available. Fifty-seven section editors and abstractors cover over 400 domestic and foreign publications and abstract the articles on metallurgical engineering as well as allied subjects.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform with our style they are classified. The section editors edit the abstracts appearing in the section in which their major interest lies.

There are usually at least two places where an abstract might fit, sometimes even more, and so we decide who will be most interested in the article. We want the abstracts to be so arranged that if a heat treater reads only Section 10 he will keep in touch with all the important articles in his field and if a foundryman will read Section 22 each month he will not miss anything important. An improvement we hope to make in the METALLURGICAL ABSTRACTS in the near future is the cross-indexing of articles, which belong under several sections. Some of the sections are descriptive and some are self-explanatory and we have so labeled them.

CLASSIFICATIONS

0 (General). Under this heading we classify all abstracts which are of interest to the metallurgical industry in general. Compare this with Section 20—miscellaneous.

1, 2, 3 (Properties of Metals, Non-Ferrous and Ferrous Alloys). An article goes under one of these heads when the properties are emphasized and not the method of determining them.

4 (Corrosion, Erosion, Oxidation, Passivity & Protection of Metals & Alloys). This takes articles on weather resistance, resistance to acids, etc., and protection against them.

5a (Structure of Metals & Alloys—Metallography & Macrography). An article would go in this group if it discussed the microscopic or macroscopic study of metals and alloys, or the determination of constitutional diagrams, critical points, etc.

5b (Structure of Metals & Alloys—Structure and X-Ray Analysis). This group includes articles dealing with the structure of metals and alloys as determined by X-ray analysis and X-ray examination.

6 (Physical, Mechanical & Magnetic Testing). If an article emphasizes the method of determining the properties of metals rather than the properties them-

selves it belongs in this section. The abstracts on fatigue appearing under this section are prepared with the coöperation of the Fatigue Research Committee of the American Society for Testing Materials.

7a (Electro-Chemistry—Electroplating). This will include articles on the electrolytic plating of metals.

7b (Electro-Chemistry—Electrometallurgy). This relates to the electrolytic recovery and refining of metals.

8 (Metallic Coatings Other than Electroplating). Articles on galvanizing, metal spraying or dip coating would come in this group.

9 (Industrial Uses and Applications). If the application of the metal is stressed rather than the properties the article belongs in this section.

10 (Heat Treatment). If heat treatment in general is discussed the article would be classed under section 10; if, however, any distinct operation is stressed it would go under the corresponding subhead.

11 (Joining of Metals and Alloys). The explanation for this group is similar to that for section 10.

12 (Working of Metals & Alloys). We feel that the divisions in this group are self-explanatory to men in the metals industries. We might say, though, that an article is classified under 12j (Cold Working) only when it will not fit under one of the other heads—for instance, an article on cold rolling would be put under 12c, rolling.

13 (Defects). This section includes articles dealing with inclusions, segregations, cracks, pinholes, blowholes and failures.

14 (Chemical Analysis). If the method of analysis is emphasized the article goes here.

15 (Historical & Biographical). Self-explanatory.

16 (Economic). Articles in this group are devoted to economic trends, savings, cost estimates, etc.

17 (Plants & Laboratories) This section includes descriptive articles.

18 (Machinery & Supplies). This includes descriptive articles.

19 (Bibliographies). Self-explanatory.

20 (Miscellaneous). This takes in all scattered articles which do not belong anywhere else.

21 (Laboratory Apparatus). Purely descriptive articles belong here. If results or processes are given they would go under 6 or 14.

22 (Foundry Practice & Appliances). This is self-explanatory.

23 (Furnaces & Fuels). This takes in descriptive articles. Otherwise they go under 10, heat treating, 10b, annealing, etc.

24 (Refractories & Furnace Materials). This section is hand-in-hand with 23. Furnace men should read both of them.

25 (Gases in Metals). This is self-explanatory.

26 (Inspection). This includes articles dealing with inspection, pure and simple—not X-ray or microscopic analysis.

27 (Effects of Elements on Metals and Alloys). Articles dealing with the effect of the addition of different chemical elements to metals and alloys are included in this group.

28 (Instruments & Controllers). Descriptive.

29 (Effect of Temperature on Metals and Alloys). This section is prepared in conjunction with the Joint High Temperature Committee of the A. S. T. M. and the A. S. M. E.

30 (Leaching). Self-explanatory.

31 (Reduction Metallurgy). This would include articles on blast furnace practice.

32 (Non-metallic Coatings for Metals and Alloys). Articles discussing painting, enameling, lacquering, etc., belong here.

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It has been our purpose in this outline to make our scheme of classification apparent to our readers and so, perhaps, make the abstract section more useful. If you have any questions pertaining in any way to the abstracts, write to us. We shall be glad to answer them in detail.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

GENERAL (0)

Important Materials Used in the Manufacture of Steel for Castings. W. C. HAMILTON. *The Octagon*, Vol. 35, May 1931, page 6.
A review of the various ferro-alloys used in the manufacture of special alloyed steels, their method of production and analysis. Ha(0)

Dr. Honda Honored for Inventions. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 19, Apr. 1931, pages 88–90.
Dr. Honda writes of three matters of metallurgical interest (1) the merger of all Japanese Steel Works, (2) a dinner in honor of certain Japanse inventions given by the Emperor; one of these inventions being K. S. or Cobalt magnet steel whose properties are described, (3) quantitative measurements of austenite and martensite in quenched carbon steels and effect of tempering, shown by a curve. WLC(0)

Treatment of Stainless Steels. R. H. KASPER. *Modern Machine Shop*, Vol. 3, Apr. 1931, pages 20, 22, 24, 26, 48.
Four different kinds of steels are described as to their chemical analysis, physical properties and the heat treatment required to bring about the best results. The best manner for forging, machining, punching, forming and drawing, grinding and polishing is discussed. Ha(0)

Quicksilver. C. N. SCHUETTE. *U. S. Bureau of Mines Bulletin* 335, 1931, 168 pages.
Schuette discusses (1) prospecting, development and mining, (2) metallurgy and (3) economics of Hg. The mechanically operated furnace has largely replaced the shaft furnace. The factors influencing this change are discussed. The consumption of Hg by uses (determined by direct inquiry of consumers) is reported. AHE(0)

Committee for Aluminum and Light Metal Alloys. Designation of the Age-Hardening Phenomenon. (Ausschuss für Aluminium und Leichtmetallegierungen. Bezeichnung des Vergütungsvorganges.) G. MASING. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 35–36.
Resolution, in agreement with the Verein deutscher Eisenhüttenleute, to replace the misleading designation "Vergütung" (improvement) used in ferrous metallurgy by the designations "Ausscheidungshärtung" (Precipitation hardening) and by "Aushärtung" (hardening out). The first term will preferably be applied in scientific discussions, while the second term, lacking a clear conception and limitation, will be used in the shop. An inquiry showed that most of the members of the Committee decided on the first designation, but both designations will be used for the present. EF(0)

The Contribution of Science to the Iron and Steel Industry. ARTHUR D. LITTLE. *Yearbook American Iron & Steel Institute*, 1930, pages 45–62.
Includes discussion. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. (0)

The Metallurgy of the Non-Ferrous Metals. WILLIAM GOWLAND. Charles Griffin & Co., Ltd., London, 1930. Cloth, 6½ × 9 inches, 633 pages. Price $15.00.
It is becoming increasingly difficult to compress the important facts in any broad metallurgical field into a single volume.
To be up-to-date in every branch of a broad field is more than can be expected from any author. General metallurgical textbooks dealing with principles, rather than processes and plant equipment, do not become outmoded so rapidly as those which tell chiefly what industry is doing. The latter class soon tend to become of greater historical than metallurgical value. Gowland's Non-Ferrous Metallurgy, was, however, so well done that it long held its position as a standard reference book. But even this is trending toward greater historical than present-day value.
The revision of Gowland for the fourth edition is stated in the preface to differ from the previous edition chiefly in changes in the sections on refractories (mostly from Sosman's monograph on silica), copper, platinum, cadmium, tin and aluminum. That on mercury might well have been rewritten also to include reference to the work of Duschak.
The section on electrolytic zinc also fails to give the reader much insight into modern practice.
If we look at the chapter on aluminum which, Bannister states, "has been largely rewritten in view of the advancement made in the metallurgy of this metal" as a sample, we find 15 pages containing these references since 1920, with no reference to the Hoopes process, one page on duralumin, with no reference to any other heat-treatable alloy and no mention of heat-treated castings. Contrast this with 1238 pages in the two volumes of the Aluminum Industry by Edwards, Frary and Jeffries, also published in 1930. How can a University professor hope to keep up with details in a score of metallurgical industries, all growing rapidly, and revise a general reference or handbook so it becomes nearly enough up-to-date to be a satisfactory source of information? The day of such books as Gowland is passing. Instead, we need small textbooks on principles, and a whole shelf of handbooks, each one revised often by specialists, for detailed reference. No very useful purpose is served by revisions such as this fourth edition of Gowland. There is probably no better single book attempting to cover this broad subject, but the task of covering so much ground between a single pair of covers has become impossible of accomplishment.—H. W. Gillett (0)-B-

Recent Developments in Nickel Iron and Steel. CHARLES MCKNIGHT. *Yearbook American Iron & Steel Institute*, 1930, pages 195–221.
Includes discussion. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 687. (0)

Tool Steel from the Consumer's Standpoint. H. G. KESHIAN. *Metal Progress*, Vol. 20, Aug. 1931, pages 46–48.
A paper to be presented in greater detail before the Boston Convention of American Society for Steel Treating in September 1931, and to be published in the Transactions later with discussion. Lack of quantitative data on the qualities of tool steel places the designer under a serious handicap. Methods of selection of tool steel are given as (1) Tradition, (2) Personal Experience, (3) Recommendation of Steel Makers and (4) Service Tests. The first two methods of selection give the designer no quantitative guide for his work. The third as shown by quotations from catalogs of steel makers is only vaguely qualitative. Service tests are of real value as "the proof of the pudding." They, however, entail considerable expense, different operators may get different results and unnoticed changes in conditions of test result in contradictions. A quantitative numerical value for such properties as wear and shock resistance, cutting quality, shrinkage, fatigue values and other properties are to be desired. The difficulties in such determinations are numerous but their prospective value offers incentive to overcome the difficulties. WLC(0)

Brobdingnagian Bridges. OTHMAR H. AMMANN. *Technology Review*, Vol. 33, July 1931, pages 441–444, 464.
Discusses the spectacular achievements of modern bridge builders: the Hudson River (George Washington) bridge, the Sciotoville bridge over the Ohio river, Hell Gate bridge, the Kill van Kull bridge, the Quebec Cantilever bridge, Manhattan bridge and others. Discusses the feasibility of a span two miles long, with consideration to type, quality of material, erection and the possibility of making bridges beautiful as well as strong. MAB(0)

New Research Objectives—Lower Costs and Greater Consumption. ARTHUR D. LITTLE. *Chemical Markets*, Vol. 28, June 1931, pages 584–586.
An address. The economic value of research is indicated by reference to the aluminum, leather, dye, plastic and other industries. WHB(0)

PROPERTIES OF METALS (1)

The Investigation of Rhenium. (Die Erforschung des Rheniums.) OTTO HUPPERT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 23, 1931, page 666.
The 75th element of the periodic system was discovered in platinum ores in 1925 by X-ray spectrographic methods. It was named Rhenium (Re) while element 43, also unknown before that date, was found simultaneously and called Masurium. Rhenium belongs to the group of manganese and, today, can be produced in any quantity at a price of about $3.50/g. Rhenium metal is a deep black powder of high volume; its melting point has been determined as 3440° C. (a little lower than for W). Mechanically, it differs widely from tungsten. In the sintered state, it is rather brittle; but heated, it can be forged and rolled; a wire is flexible as copper wire. A rhenium wire with a core of tungsten of 0.030 mm. diameter showed a tensile strength of 50.6 kg./mm.² The crystal lattice shows a hexagonal structure. Atomic weight is 186.31; density, 20.53; measurements of electric conductivity gave a specific resistance twice as high as W. Rhenium colors the Bunsen flame a pale green; it has some characteristic bands in the green range of the spectrum. The technical applicability of the new metal is being investigated at present. Ha(1)

Electrical Resistivity of Italian Aluminum Wire. (Relazione sulle misure eseguite nel Laboratorio di Elettrochimica ed Elettrometallurgia della R. Scuola di Ingegneria di Milano sull'alluminio trafilato, crudo, prodotto in Italia.) O. SCARPA. *La Metallurgia Italiana*, Vol. 23, Feb. 1931, pages 102–105
Electrical resistivity was determined on 300 samples of aluminum wire made in Italy. The values in microhms/cc. at 20° C. ranged from 2.79 to 2.93. Only 4% were below 2.82, and only 5% above 2.89. The maximum frequency was at 2.845, the arithmetical mean 2.851. No figures are given on temperature coefficient of resistivity nor for the chemical analysis of purity. The average specific gravity was 2.705 at 20° C. The value 2.845 is stated to correspond to 60.6% of the volume conductivity of domestic copper. The samples were probably hard-drawn. HWG(1)

Iron Gives Up Its Innermost Secrets. R. L. DAVIDSON. *The Pure Iron Era*, Vol. 9, 1931, pages 16–17, 23.
Shows diffraction patterns of iron. Ha(1)

Titanium. E. P. YOUNGMAN. *Information Circular* 6365, *United States Bureau of Mines*, Oct. 1930, 39 pages.
The subject is discussed under the following headings: properties, utilization, history, ores and minerals, identification, mode of occurrence, mining and concentration, deposits, world production, domestic production, imports, exports, prices, metallic alloys, pigments, and lists of dealers. Over 40 footnote references are given. AHE(1)

Zirconium. Part I. General Information. E. P. YOUNGMAN. *Information Circular* 6455, *U. S. Bureau of Mines*, June 1931, 30 pages.
The properties, uses, occurrence, concentration, preparation, production, markets and prices, etc., of zirconium metal, its alloys and its oxide are discussed. Seven recent patents are abstracted and 25 footnote references are given. AHE(1)

The Nickel Industry. A. J. WADHAMS. *Metal Progress*, Vol. 19, March 1931, pages 92–98.
The author describes the occurrence of nickel, its recovery from the ore and the uses of its various alloys as well as those of pure nickel and its salts. WLC(1)

Note on Applications of Data on the Thermal Conductivity of Metals. M. S. VAN DUSEN (Bureau of Standards). *Preprint* for A. S. T. M.–A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 545-549.
In many thermal conductivity problems, transfer resistance is so high through a joint that attempts to increase heat flow by using a metal of higher thermal conductivity are futile. In heat transfer through a metal wall between condensing vapor on one side and a boiling liquid on the other, thermal conductivity may come in. It is also important in automotive engine design. It comes in in heating and quenching of steels, and in molds for casting. Diffusivity is the important factor, and is usually nearly proportional to conductivity. Heat capacity per unit volume is more important than specific heat. A unit volume of Al has about the same heat capacity as one of any other metal. In any problem attention should be directed to the magnitude of the various resistances to heat flow before worrying about the conductivity of any metal part. No quantitative data are included in the paper. HWG(1)

Some Series in the Extreme Ultra-Violet Spark Spectra of Copper. F. C. CHALKLIN (University of Sheffield). *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Oct. 1930, pages 711–721.
Theoretical arrangement of many of the critical potentials of copper in a series. RHP(1)

On the Plasticity of Metals. ZAY JEFFRIES. *Mechanical Engineering*, Vol. 53, Apr. 1931, pages 262–266.
Presented at the 87th meeting of the American Association for the Advancement of Science, Cleveland, Ohio, December 31, 1930. Plasticity is defined as "the quality by virtue of which a substance may undergo a permanent change in shape without rupture." Metals are crystalline, and plastic flow is the result of the movement of one position of a crystal with reference to another along crystallographic planes. Industrial metals are useful to us because of their high plasticity, without which metal-working processes could not be carried on. Some of the headings: Plastic Deformation of Single Crystals; Preferred Orientation Common in Industrial Wrought Metals; Small Loads Required to Fracture Single Crystals; Rate of Loading an Important Factor; The Wonderful Nature of Plasticity in Metals; Possibility that Free Electrons Are Essential for Metallic Plasticity; Face-Centered Cubic Metals Retain Plasticity at Very Low Temperatures. MFB(1)

The Effect of Systematic Surface Treatment on the Photoelectric Emission from Metals. R. F. HANSTOCK. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Nov. 1930, pages 937–944.
Gives results of research on the photoelectric emission from metal surfaces in a vacuum at intervals during the process of polishing, the surface being initially in an annealed state. Materials tested were Cu, Ag, Au and Pt polished with steel and nickel. All the metals give curves of similar shape. The photoelectric current increases as the metal is changed from annealed to a polished state. RHP(1)

Heat-Treatment, Ball-Hardness, and Allotropy of Lead. F. HARGREAVES. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 149–174.
Includes discussion. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 897. (1)

On the Hardness of Electrodeposited Metals and on the Change in Hardness in Relationship to Hammering. (Ueber die Härte elektrolytisch hergestellter Metalle und die Aenderung der Härte als Funktion des Hämmerns.) GUICHARD. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, pages 205–206.
Briefly reviews a lecture delivered at the International Congress of Mining, Metallurgy and Applied Geology, Liege, June 1930. EF(1)

NEW PRODUCTS

New Sheet Metal Tester

The Wazau sheet metal tester sold by the Baldwin-Southwark Co., Philadelphia, Pa., is a deep drawing press for drawing cups (as shown in Fig. 2) from circular sheet blanks. The male die (1 in Fig. 1) of 30 mm. diameter is motor driven and the drawing force exerted by it is measured by a hydraulic capsule, indicating the load on dial 2.

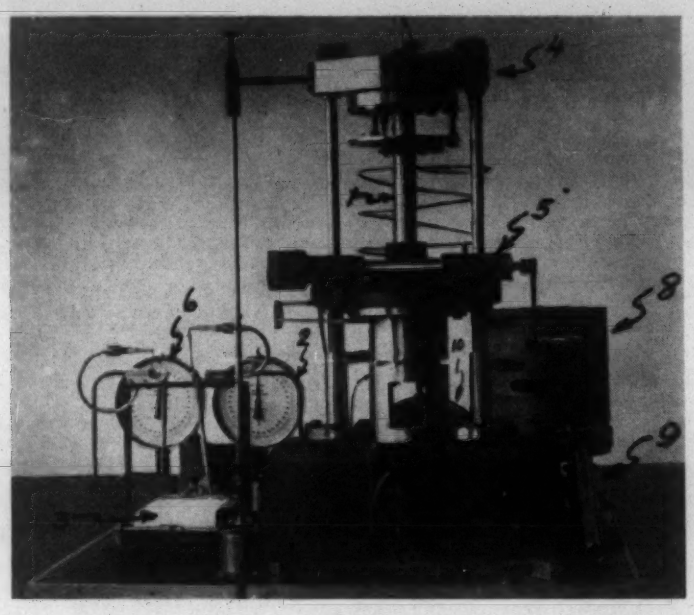

Fig. 1

There are two ranges of sensitivity of 10,000 and 20,000 lbs. for the standard type of the tester, which is built in higher capacities, if desired. On the paper strips 3, a record is made of drawing force. The die 1 is attached to the upper crosshead 4, which is driven by a reversible motor, 10.

The deep drawing speed normally amounts to about 4″ per minute, but can be adjusted to other values on request.

The middle crosshead 5 carries the hold-down or blankholder, which is adjusted by hand, because it has to make small movements only. It is of particular advantage that in the Wazau sheet metal tester the pressure of the blankholder can be varied at will and measured, while in normal testers, no check of the blank holder force is possible. The blank holder loads are indicated on dial 6 and recorded on paper strip 3. Both the drawing and the hold-down force are recorded in function of the depth of draw. In this way all important variables can easily be studied and the records leave no doubt whatsoever.

The hold-down pressure is not only indicated and recorded, but can be maintained at any definite value desired, by means of a special load maintainer. This device consists of a dead weight accumulator 8 and hand pump 9. The innovation is important in that all uncertainties of tight or loose fitting of the hold-down are eliminated and the trend in practical drawing is closely imitated.

It is advisable to qualify sheets by arbitrarily selecting a certain blank diameter and drawing cups with different blank holder loads. Two things may then happen: first, failure occurs at a certain blank holder load, which thus forms a criterion, together with the initial blank diameter. If two sheets show the same qualities in this way, there may still be a difference in drawing forces permitting clear differentiation. The second case occurs when the sheet does not fail even at the highest blankholder load available. The high drawing capacity indicated hereby may then be tested by using a larger initial blank diameter and repeating the first method of test until failure occurs.

The entire procedure is autographically recorded in every step and in addition to such data as depth of draw, blank holder and drawing force, the inspection of cups drawn furnishes useful information.

Tests of this kind are recommended for testing sheet material as per the attached table that shows a series of tests on one steel in 5 different stages of treatment. No. 11 could be drawn from a blank 2.44″ diam. up to 7700 lbs. blank holder load, while No. 12 failed as soon as the blank holder load exceeded 1100 lbs. No. 13 showed almost the same behavior as No. 11, but it required higher drawing forces (see last two columns). No. 14 is better than No. 12 in that it could be drawn up to 2200 lbs. blank holder load. No. 15 is not much different from No. 12, but slightly harder to draw (higher drawing loads).

The order of materials as to drawing capacity determined from this actual series of tests is: 11, 13, 14, 12, 15. It may be mentioned that these results checked very well with practical drawing experience although no ordinary "ductility tester" could give such clear and correct discrimination.

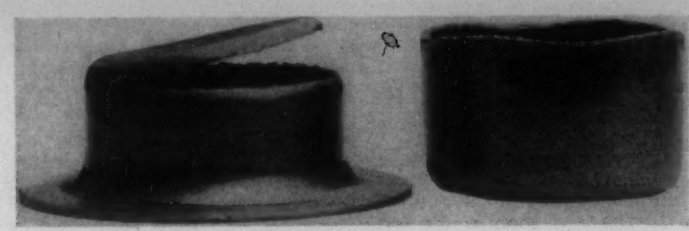

Fig. 2.

Another method of test consists in using the same blank holder load all the time and gradually increase the blank diameter until the sheets fail. The highest diameter furnishing good cups together with the drawing force may be taken as a measure of drawing capacity.

The tester can also be used to determine the best lubricant as well as radii of fillets, clearances and so forth, in other words those factors involved in the drawing process not depending on the material itself but on the design of the drawing machine.

Sheet Tests Group 3. Samples 11–15.

Material	Thickness	Die thickness	Specimen	Sample broke		Draw finished		Deep draw. Force (Max.)	
				blank diam. inch	blank holder load (lbs.)	blank diam. inch	blank holder load (lbs.)	lbs. Load	lbs./in² Stress
No.	inch	inch	No.						
			11–1			2.44	5500	8010	53900
11	0.0382	0.0394	11–2			2.44	7700	8070	54300
			11–3	2.52	2200			8100	54500
			11–4	2.52	1100			8230	55400
			12–1	2.44	5500			9240	62200
12	0.0375	0.0394	12–2	2.44	3300			9150	61600
			12–3			2.44	1100	9030	60800
			12–4	2.44	2200			9380	63200
			13–1			2.44	7700	8760	78300
13	0.0327	0.0296	13–2	2.52	2200			8480	75600
			13–3	2.52	1100			8450	75500
			13–4	2.44	7700			8520	76000
			14–1	2.44	7700			6720	60000
14	0.0323	0.0296	14–2	2.44	5500			6670	59500
			14–3			2.44	1100	6560	58600
			14–4			2.44	2200	6600	58900
			15–1	2.44	7700			7080	63200
15	0.0331	0.0296	15–2	2.44	2200			7040	62800
			15–3			2.44	1100	6840	61100
			15–4			2.44	1100	6930	61800

Diam. of male die: 1.182″.

On the Wazau Sheet Metal Tester simnltaneous measurements of the following quantities are made:

Initial bank diameter.
Blankholder load.
Deep drawing load.

The first criterion is the blank diameter. Since the tester applies a male die of 1.182″ diameter, the ratio of blank diameter to die diameter gives a measure of depth of draw. The depth of draw is also indicated on the recorder paper strip and can in addition to that be measured on the finished cup.

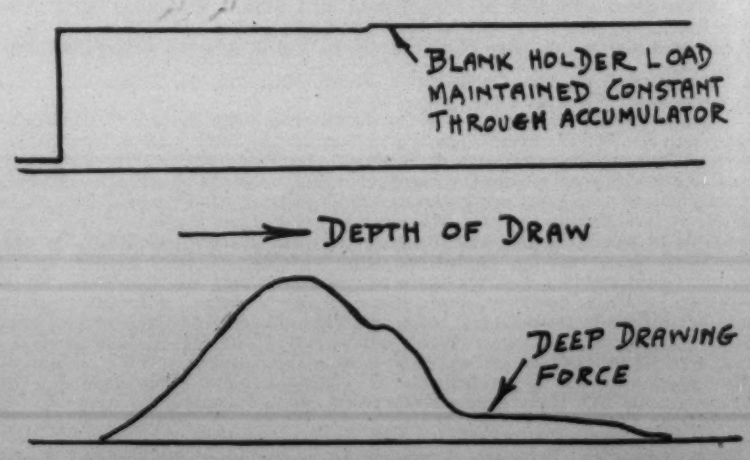

Fig. 3 Sample of autographic record on Wazau Sheet Metal Tester (1/2 nat. size)

It is obvious from experience with other sheet metal testers that the measurement of depth of draw alone is not sufficient to discriminate between materials of different drawing quantities. For this reason, the Wazau tester permits obtaining additional information through the blank holder load.

(Continued on Page 212)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Dimensional Stability of Heat-treated Aluminium Alloys. J. D. GROGAN & D. CLAYTON. *Metal Industry*, London, Vol. 38, Apr. 10, 1931, pages 379–382.

Condensed from paper read before Institute of Metals, March 12, 1931. It was found that secular changes which occur after the normal aging process is substantially completed on "Y," Duralumin and "2L5" alloys, were negligibly small. No secular change occurred after machining aged specimens. Considerable dimensional changes occurred when material quenched in cold water was machined, but quenching "Y" and Duralumin in boiling water reduced these changes to relatively small proportions. PRK(2)

Beryllium-Containing Aluminum Alloys. (Berylliumhaltige Aluminiumlegierungen.) GEORG MASING & LISEL KOCH. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 15–24.

The wear resistance of an aluminum piston alloy with 12% Cu on a steel disc was almost doubled by the addition of 4 to 8% Be. The wear of the steel disc increased in the same amount. The tensile properties of Y alloys and piston alloys cast in sand and iron molds are influenced rather unfavorably than favorably by additions of 0.05 to 2 and 8%. The refinability of these alloys is not influenced by Be additions. Several % Be added to silumin increases the elongation if refining by sodium is applied at the same time. This is due to the favorable influence of Be on the structure by forming a ternary eutectic of about the following composition: 13% Si, 1% to 1.5% Be, the remainder Al. Tables and microphotographs are reproduced. Ha(2)

The Alloyability of Beryllium with Calcium and Magnesium. (Ueber die Legierbarkeit des Berylliums mit Calcium und Magnesium.) WILH. KROLL & ERNA JESS. *Wissenschaftliche Mitteilungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 29–32.

Microscopic examination has shown that boiling magnesium does not dissolve beryllium. In boiling calcium, however, a metallic body originates, consisting of a calcium-free core of Be and a mantle of a Ca-Be alloy of about 71% Be and 27% Ca. Under certain conditions, beryllium-containing magnesium alloys could be made, all of which showed, macroscopically as well as microscopically, numerous segregations of beryllium By diluting these high percentage alloys with Mg, other melts were obtained which also showed the beryllium segregations. All of these alloys had bad aging and mechanical properties. A table of numerical values and the thermal treatment is given. Ha(2)

Ternary Alloys of Lead. S. J. NIGHTINGALE. *British Non-Ferrous Metals Research Association, Development Report* D 3, 1929, 12 pages.

The properties of Pb alloys containing (a) 0.25% Cd and 0.5% Sb and (b) 0.25% Cd and 1.5% Sn are compared with those of pure lead as regards their utility for the manufacture of pipe. The tensile strength of the alloys is 1.62 tons/in.^{2} compared with 0.9 ton/in.^{2} for pure lead, the ductility 52–55% against 80%, and the fatigue limit 0.74–0.57 ton/in.^{2} against 0.18. The alloys are on the whole more resistant to corrosion than is lead and withstand a considerably higher bursting pressure, so that a lighter pipe can be used for the same service than is the case with lead. The working and soldering properties of the alloys are equally as good as those of lead and, taking into account their superior properties, are relatively less costly than lead. They do not undergo intercrystalline corrosion or fatigue. (2)

"Everdur," a Copper Alloy with High Mechanical Properties and Great Resistance to Corrosion. ("Everdur," lega di rame con caratteristiche meccaniche elevate a grande resistenza alla corrozione.) L. GIROLA. *La Metallurgia Italiana*, Vol. 23, May 1931, pages 383–389. 7 figures, 5 references.

General discussion of this Cu-Si-Mn alloy and its properties, as manufactured by the Società Metallurgia Italiana. HWG(2)

A New Silicon-Zinc-Copper Alloy. Parts 2 and 3. E. VADERS. *Metal Industry*, N. Y., Vol. 29, Apr. 19, 1931, pages 155–156; May 1931, pages 196–198.

Tin added to silicon-zinc-copper alloys would increase their value as bearing alloys. These alloys have same tone characteristics as bronzes for making bells. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. PRK(2)

A Study of Tin-Base Bearing Metals—II. G. B. KARELITZ & O. W. ELLIS. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 2, 1930, *Machine Shop Practice*, pages 87–99.

Includes discussion. The paper deals with the mechanism of wiping of babbitt linings, with certain phenomena observed during the casting of tin-base alloys, and with the effects of cold work on them. It is shown that wiping of babbitts is a result of the upper layer of the lining's reaching the solidus temperature, when the constituent with the lowest melting temperature liquefies, the babbitt becomes "mushy," and is therefore wiped by the journal. The appearance of the castings of various chemical composition is discussed, and the variation in hardness and microstructure due to cold work is given. See also *Metals & Alloys*, Vol. 1, May 1930, page 527. (2)

Elektron. *Metal Industry*, London, Vol. 38, Apr. 3, 1931, pages 356, 367.

There are two main groups of Elektron or magnesium base alloys: those weldable by oxy-acetylene flame and those not weldable. This metal can only be worked around 300° C. PRK(2)

Bearing Alloys. R. T. ROLFE. *Transactions, Manchester Association of Engineers*, 1929–30, pages 14–97. Includes discussion and 41 figs.

If lubrication always kept bearing surfaces apart, the nature of the bearing surfaces would be immaterial, but the oil film may break down and give metal to metal contact. Information as to the best alloys for use in such conditions is best obtained by making tests in the dry or only slightly lubricated condition. A bearing metal had best be hard if it is given a mathematically perfect fit. As this can seldom be approached, the usual method is to use a somewhat plastic matrix in which hard grains are embedded. This will squeeze down to a better surface. Except for small bearings, babbitt metal must be backed up by a stronger shell. Lead base alloys can be used for rather high temperatures if the heat is frictional, but in auto bearings, affected by heat from other sources than the bearing itself, the softer alloys do not serve so well. The Sn-Sb-Pb eutectic (53, 4 and 43%, respectively) melts at 177° C. and many automotive engineers object to the presence of any Pb in a Sn base babbitt. Unusual compositions, used in a vessel of the German Navy, the *Baden*, contain 1.7 to 2.3% Cu, 0.6% Pb, 3.5 to 6.5% Hg, balance Sn. The Hg is in solid solution in the tin matrix. The requirements for a babbitt are that it be readily melted, poured and machined, should have high compressive strength at working temperatures, low wear, low coefficient of friction and some plasticity. At one extreme of composition, there are no hard crystals in the matrix, at the other, the hard crystals touch each other, and crack under load instead of bending down in the matrix. Either extreme is bad, anything between may suit some service conditions. Adhesion of babbitt to gun metal, cast iron and steel was experimentally determined. Gun metal gave the same results smooth machined or rough machined. Smooth machined steel gave better adhesion than gun metal, but rough machined steel gave worse. Adhesion to machined cast iron was very poor. Comments are made on methods of lining bearings. The Pb base and the bronze bearing alloys are discussed. Annealed gun metal, free from the δ-constituent, wears readily and is not useful for bearings. Non-plastic Zn base bearing alloys have a limited use. The whole bearing should be made of the alloy as it is difficult to line shells with it. HWG(2)

PROPERTIES OF FERROUS ALLOYS (3)

Iron Chromium, Iron-Chromium-Nickel and Related Alloys. Report of A. S. T. M. Committee A-10. J. STRAUSS, Chairman. *Preprint* No. 17 for June 1931 Meeting, *American Society for Testing Materials*. 3 pages.

Atmospheric corrosion tests of these alloys, and the preparation of standard samples and methods of chemical analysis, are being considered. Cooperative acid immersion, copper sulphate stain, and salt spray tests are being carried out in 15 laboratories. Work on methods for determination of elastic and impact properties, and study of grain growth and embrittlement of low carbon plain chromium steels is contemplated, and welding is being looked into. HWG(3)

Welding of Corrosion Resisting Steels. WM. SPRARAGEN. *Welding*, Vol. 1, Nov. 1930, pages 897–900.

Discussion of the physical properties of 4 groups of alloy steel: (1) chrome irons, (2) chrome steels with over 0.2% C, (3) chrome-nickel irons with less than 0.2% C, (4) chrome-nickel steels with more than 0.2% C. Their weldability is considered and brief mention is made of certain precautions necessary in welding. Ha(3)

Steel Personality. B. F. SHEPHERD (Ingersoll-Rand Co.). *Metal Progress*, Vol. 19, Feb. 1931, pages 51–58.

A paper presented before the Western Metal Congress, San Francisco, Feb. 16, 1931, and published with discussion in the Transactions. The author defines "timbre." He shows hardening irregularities in tool steel, effect of timbre on service life, necessity for control of timbre, difference in timbre in products of several manufacturers, effect of abnormality, and that timbre exists not only in tool steel but in various alloy steels. Hardenability tests are described and discussed, illustrated by photographs. Micrographs show abnormality features of three steels. Effect of furnace practice on timbre, and variability in response to heat treatment in steels are discussed. WLC(3)

Thermodynamics of a Heat-Treated Steel. F. G. SEFING. *Michigan Engineering Experiment Station Bulletin*, No. 37, Vol. 6, May 1931, 13 pages, 9 references.

Study of storing of energy in steel during heat-treatment. Strips of 1.26% C, 0.37% Mn, 0.22% Si, 0.022% P, 0.012% S, 0.38% Cr steel were quenched from 1380° F. into water at 70° F. and tempered at 122° to 1382° F. They were dissolved in a $FeCl_3$-NH_4Cl solution in a calorimeter, without gas evolution. The undissolved residue is said to be nearly equal to the combined weight of the carbon and the Fe_3Si of the samples. No proof is adduced that Fe_3Si was in the residue. The total heat evolved in cal./g. ranged from 894 to 875. At draw temperatures up to 392° F. from 13 to 20 cal./g. more were evolved than on that annealed at 1392° F. With one specimen drawn at 350° F. slightly out of line, from 482° F. up, the excess heat evolved gradually decreased from 8 cal./g. to zero. Accuracy to 2 cal./g. is claimed. Length changes on quenched and tempered cylinders of the same steel were measured immediately and again after 10 months. The results were not especially consistent. HWG(3)

Strength of Rectangular Flat Plates under Edge Compression. LOUIS SCHUMAN & GOLDIE BLACK. *Report* No. 356, *National Advisory Committee for Aeronautics*, 24 pages.

Flat, rectangular plates of duralumin, stainless iron, Monel metal, and nickel were tested under loads applied at two opposite edges and acting in the plane of the plate. The edges parallel to the direction of loading were supported in V grooves. The plates were all 24″ long and varied in width from 4″ to 24″ by steps of 4″, and in thickness from 0.015″ to 0.095″ by steps of approximately 0.015″. There were also a few 1, 2, 3 and 6″ wide specimens. The loads were applied in the testing machine at the center of a bar which rested along the top of the plate. Load was applied until the plate failed to take any more load. The tests show that the loads carried by the plates generally reached a maximum for the 8-or 12-inch width and that there was relatively small drop in load for the greater widths. This is explained by the fact that when the plate buckles, since the greatest deflection occurs at the center, its vertical chords will shorten more there than at the ends. In consequence there will be less load on the plate at the center and more toward the ends where it is better supported to resist bending and can continue to take load after buckling has occurred. In this way, the load carried by plates of a given thickness would tend to be constant for all plates wider than that at which the maximum load is reached. Deflection and set measurements perpendicular to the plane of the plate were taken and the form of the buckle determined. The number of buckles was found to correspond in general to that predicted by the theory of buckling of a plate uniformly loaded at two opposite edges and simply supported at the edges. (3)

Some Physical Properties of Hardened Tool Steel. J. V. EMMONS (Cleveland Twist Drill Co.). *Preprint* No. 35 for June 1931 Meeting, *American Society for Testing Materials*, 30 pages, 14 references.

Torsion tests were made on specimens with 3/16″ diameter, 3″ test length on a steel of 1.12% C, 0.19% Mn, 0.30% Si, 1.07% Cr, oil quenched from 1450° to 1850° F. by 100° intervals, and drawn at 212° F. and from 350° to 750° F. at 50° intervals. The toughness (angular deformation in torsion test) varied greatly with the heat-treatment. Greatest toughness was found at 1750° F. oil 450° F. Although this gave 62.5 Rockwell C, the torsion specimen twisted through more than 360° before breaking. The "coefficient of toughness," the product of ultimate torque, in lbs. at 1 in. radius, times the angular deformation in degrees, varied from 6,000 for the highest quench and lowest draw up to 136,000 for the 1750–450° F. treatment. Other high values and the corresponding Rockwell C figures were 1550–350° F., 72,000, 62.9; 1650–350° F., 74,000, 65.6; 1650–400° F., 104,000, 63.6; 1650–450° F., 88,000, 61.4; 1750–400° F., 71,000, 63.3; 1750–450° F., 136,000, 62.5; 1750–500° F., 95,000, 59.7. Toughness is a long way from being proportional to drawing temperature as is usually assumed, nor is toughness inversely proportional to hardness. The microstructures are correlated with the mechanical tests and theoretical explanations of the phenomena discussed. The Rockwell hardness of the martensite may be explained on the basis of the size of submicroscopic particles of ferrite alone. Maximum toughness is thought to be at the point where carbide particles are in an early stage of growth and exert least resistance to slip interference, maximum strength at a later stage when they exert greatest resistance. If part of the martensite is decomposing to give carbide particles of one of these sizes and part to those of the other, great strength and toughness may be met in the same specimen. The torsion test method is advocated for determination of toughness in steels too hard and brittle for other types of test to reveal differences in toughness. HWG(3)

The Tensile Properties of Cast-Iron Sample Rods Cast Upright or Horizontally. (Ueber Festigkeitswerte von stehend und liegend gegossenen Gusseisen-Probestäben.) K. L. ZEYEN. *Krupp'sche Monatshefte*, Vol. 12, Apr. 1931, pages 57–62; *Giesserei*, Vol. 18, Feb. 27, 1931, pages 177–180.

The bend test is very often used for cast-iron because of its simplicity and cheapness. The sample rod can be cast either horizontally or vertically. Tests showed that the figures for vertically cast rods are better than those of horizontally cast rods. The tensile strength was more uniform for the vertically than for the horizontally cast rods. Some other tests corroborated the fact that additions of nickel and chromium improve the tensile strength of cast-iron. 9 references are cited. Ha(3)

High Elastic Limit Steels. Correspondence from C. H. DESCH, Sheffield, England. *Metal Progress*, Vol. 18, Nov. 1930, pages 85–86.

The writer describes certain developments in high elastic limit steel for ship building and method of test. WLC(3)

Relation between Magnetic Properties, Impact Strength and Hardness. H. STYRI (S K F Industries). *Preprint* No. 33, for June 1931 Meeting, *American Society for Testing Materials*, 12 pages.

A 1.03% C, 0.33% Mn, 0.27% Si, 1.50% Cr, 0.32% Ni steel was oil quenched at 800° to 875° C., and water quenched from 800° to 845° C. These specimens were tested, undrawn and drawn at 150°, 180° and 210° by 4 different magnetic methods, by Rockwell hardness and Charpy impact. The magnetic tests showed a fair degree of correlation with the other tests. Uniformity of heat-treatment within commercial tolerances can be checked magnetically with a reliability and accuracy equal to the usual mechanical methods of control. HWG(3)

Filling Their Niche. R. A. ZIMMERMANN. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 35–36.

Describes a few of the stainless steels made by the U. S. Steel Corporation in collaboration with the Fried. Krupp Works in Germany. Ha(3)

Steel. Report of A.S.T.M. Committee A1. J. B. YOUNG, Chairman. *Preprint* No. 9 for June 1931 Meeting, *American Society for Testing Materials*, 26 pages.

Progress reports on various committee and sub-committee activities. Changes are proposed in several specifications now reading that the steel shall be made by either or both the Bessemer or open-hearth process, to read "by one or more of the following processes, open hearth, electric furnace, or acid-bessemer." Elongation in 2″ for structural silicon steel is put at 1,600,000 divided by tensile strength. Details of boring and rough-turning for locomotive axles, shafts, and similar forgings are given. Silicon in heat-treated carbon steel helical springs is set at 0.15% minimum and the former 0.30% maximum limit removed. Comments on steels suitable for fusion welding are made. It is stated that while higher carbon content steels are successfully welded, present commercial practice limits carbon to 0.30% in open-hearth and 0.15% in Bessemer. Transverse welds in seamless steel pipe are made up to 0.35%. Proposed tentative specifications are offered for normalized and tempered alloy steel for forgings. On forgings not over 14″ diameter or thickness, 7″ maximum wall, properties on Class A are: 80,000 tensile, yield point 0.67 × tensile, elongation in 2″, 28%, reduction 56%. For Class B, 90,000; 0.62 × tensile, 22%, 42%. Compositions stated to give these properties (composition not required) are: Class A, 0.20–0.30% C; 0.80–1.00 Mn; 2.50–3.00 Ni; Cr not over 0.40; V not over 0.05; Class B, 0.42–0.57% C; 0.70–0.95 Mn; not over 0.25 Ni; not over 0.40 Cr; not less than 0.15 V. Those for flange and firebox steels for forge welding require, Grade A, flange 45,000 tensile, yield 0.5 × tensile, and not less than 24,000, elongation in 8″, 1,500,000 ÷ tensile, in 2″, 1,600,000 ÷ tensile. Grade A firebox, same except elongations are 155,000 and 1,650,000 ÷ tensile. Grade B, flange 50,000; 0.5 × tensile, and not less than 27,000, elongation 8″, 1,500,000 ÷ tensile, 2″, 1,600,000 ÷ tensile. Grade B, firebox, same as flange except elongations, which are as in Grade A, firebox. HWG(3)

Permeability of Hipernik Reaches 167,000. T. D. YENSEN. *Electric Journal*, Vol. 28, June 1931, pages 386–388.

Hipernik is a refined iron-nickel alloy, made by removing small amount of impurities, chiefly oxygen, from the ordinary 40–60 alloy. A difference in the amount of aggregate impurities of a few hundredths of 1% accounts for differences in magnetic properties of several hundred percent. Curves compare hipernik with 4% silicon-iron. A maximum μ = 167,000 was obtained from a lot of hipernik, the base of which was manufactured in a commercial steel plant and the punchings from which were annealed in a commercial type furnace. Hipernik is being used in rapidly increasing quantities as cores for instrument transformers. The high permeability and the low loss reduce the ratio errors and phase angle deviations to negligible quantities. WHB(3)

Mechanical Properties of Nickel Steel at Elevated Temperatures. E. PIWOWARSKI & H. NIPPER. *Foundry Trade Journal*, Vol. 43, Nov. 20, 1930, page 360.

Abstract translation of article in *Giesserei*, No. 14, 1930. Gives method and results of investigation. Steels used were melted in basic open-hearth furnace. Composition of the steels:

% C	% Si	% Mn	% P	% S	% Ni	% Cr
0.33	0.36	0.88	0.043	0.030	....	....
0.35	0.31	0.88	0.017	0.025	1.54	0.23
0.35	0.31	0.82	0.017	0.026	300	0.20

Impact hardness of steels decreases with increase of temperature until a minimum value of about 400° C. is reached, then hardness increases up to 600° C. and then it rapidly decreases. Tensile strengths increase from room temperature to 200° C., maximum value at 300° C. Elongation and reduction of area show maxima at between 100° and 200° C. and minima at 300° C. VSP(3)

The Direct Buoyancy Method and the Density of Molten Metals, Especially of Iron Alloys at Temperatures Up to 1600° C. (Ueber die direkte Auftriebsmethode und die Dichte schmelzflüssiger Metalle, insbesondere von Eisenlegierungen bei Temperaturen bis 1600° C.) ERICH WIDAWSKI. Doctor's Thesis. Published by Leo Voss, Leipzig, 1930, 16 pages.

The density of materials, especially of metals in the liquid state, can be very exactly determined by measuring the buoyancy of another material, such as a ceramic body, in it. Certain precautions must be observed and the vessel containing the molten metal must be so arranged that it can be evacuated in order to eliminate errors by gases rising from the melt. The apparatus built for this investigation is described and the theory of the measurement briefly developed. Determinations have been made for tin, copper and copper-tin alloys, iron and steel in liquid state with a carbon content from 0.0 to 4.2% and, in addition, the cubic expansion of refractory materials are given. The volume of Fe-C alloys is found smaller than that computed from the law of mixtures which seems to point to the existence of a compound FeC_3 in the liquid state. Silicon increases the specific volume of liquid Fe-C alloys by 0.0010 cm.^{3}/g. for a Si addition of 1%. Ha(3)

Influence of Rolling and Annealing on the Strength of Thick Sheets. (Einfluss der Walz- und Glühbehandlung auf die Festigkeitseigenschaften von Grobblechen.) K. WALLMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 21, 1931, pages 368–369.

Tests were made on 3 German steels and one American steel for structural purposes to find the influence of the degree of change in rolling, rolling end-temperature, annealing temperature and cooling speed on tensile strength, yield point, elongation, reduction of area, notch toughness, and aging. The conclusions are, briefly: great change in rolling and low end-temperature always increase elongation and yield point. Soft steel should not be rolled below 900° C. because it decreases the notch toughness. High rolling temperature will not fully replace subsequent normalizing, although it may reduce the necessity for annealing. Elongation and reduction of area are increased only slightly by annealing. Annealing offers, however, a great advantage if tensile strength or hardness is to be reduced in alloyed or carbon-rich steels to obtain better workability, or if the harmful effect of a cold working is to be eliminated. The tendency to aging becomes a little more pronounced by annealing even if the steel is cooled rapidly. In any case, delayed cooling results in deterioration of the material. Good qualities can be obtained only by quick cooling in air. Ha(3)

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CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Combating Corrosion in the Oil Industry. V. V. KENDALL & F. N. SPELLER (National Tube Co.). *Metal Progress* Vol. 19, Feb. 1931, pages 40–45, 113.

Being part of a paper presented before the Western Metal Congress, San Francisco, Feb. 16, 1931, and published in full in the Transactions as "Recent Developments in Corrosion Prevention of Ferrous Metals," with discussion. Accomplishments in corrosion prevention are recounted, addition of 0.25% copper to steel, de-aeration and water conditioning, film-forming inhibitors, suitable coatings for protection against soil corrosion, paints and lacquers for outside protection, new alloys and protective films for protection in the oil industry where corrosion losses are equivalent to 1¢/gallon on the gasoline production. The efforts of the American Petroleum Institute have been very helpful in emphasizing the problem and getting results. Corrosion conditions in the producing fields are described and discussed. Service tests on special steels are reported. Each application requires individual study. WLC(4)

An Introduction to Corrosion Resisting Alloys. CHARLES A. SCHARSCHU (Allegheny Steel Co.). *Metal Progress*, Vol. 19, May 1931, pages 46–49.

The author discusses chromium iron stainless alloys with diagrams showing the effect of 14% and 18% chromium on the iron-carbon diagram. Cutlery applications and heat treatments of higher carbon varieties, with physical properties obtained are given. WLC(4)

The Time Factor in Anodic Passivation of Metals. WILLIAM JAMES SHUTT & VINCENT JACKSON STIRRUP. *Transactions of the Faraday Society*, Vol. 26, Part 2, Nov. 1930, pages 635–642.

Experiments made with a gold anode in acid chloride solution (2N) and with Swedish iron in 2N H_2SO_4 are described. Measurements of the time of passivation and of the time of recovery from passivation were made. The rate of recovery was found to be independent of the strength of the passivating current, while the time of passivation was found to be dependent on both current density and temperature. The results are felt by the authors to be most readily explained on the basis of the oxygen theory elaborated by Muthmann and Freunburger and are very completely discussed in the light of this theory. OWE(4)

Rust Protection of Wrapped Parts. BERNARD JEFFS. *Houghton's Black & White*, Vol. 3, Dec. 1930, pages 18–21.

The importance of maintaining a bright surface on many metal products for sales purposes (tools, precision instruments, etc.) is pointed out and the different treatments in use for anti-friction bearings, razor blades, etc., are described. The selection of the rust preventive has to take into account whether or not an oily, greasy film is objectionable. Ha(4)

Rust Prevention during Shut-Downs. BERNARD JEFFS. *Houghton's Black & White*, Vol. 3, Mar. 1931, pages 16–17; Apr. 1931, pages 17–21; June 1931, pages 14–15.

Attention is called to the fact that lubricating oils are not rust preventives. In the case of scientific instruments, delicate parts, etc., a rust preventive which imparts a hard, dry, tenacious, non-porous film should be used; for tools, a non-drying grade should be employed. Ha(4)

Corrosion Test for Research and Inspection of Alloys. WILLIAM R. HUEY (E. I. duPont de Nemours & Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1126–1143.

Paper presented before the 12th Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The author stresses the need for an accurate corrosion test. The development of composition, and the influence of heat treatment on the corrosion resistance are discussed. A test designed to accurately differentiate between minor changes is described and data obtained by its use are given. WLC(4)

The Initial Corrosion Rate of Steels. H. O. FORREST, B. E. ROETHELI & R. H. BROWN. *Industrial & Engineering Chemistry*, Vol. 22, Nov. 1930, pages 1197–1199.

Concluded from this study, are the following: Oxide-free surfaces of Cr-Ni steels have finite and high initial rates of corrosion which are nearly equal to that of ordinary steel. Cr and Cr-Ni steels resist corrosion in water because of the formation of resistant oxide or hydroxide films on the surface of the metal. Differences in corrosion resistance of steels and steel alloys are due to differences in the physical and mechanical properties of the films formed. 7 references. MEH(4)

Consider Your Wear Problem as a Machining Problem. H. W. GILLETT. *Ceramic Age*, Vol. 16, Dec. 1930, pages 317–320.

The author considers the problem of wear as a type of machining or grinding or, in general, as the removal of metal, and tries, from this point of view, to find the proper materials to resist a particular wear. Hardness and toughness are the properties which every wear-resisting material must possess in a combination to suit a particular case. The various materials at present on the market are discussed and their properties described. Ha(4)

The Chemical Resistivity of Pure Aluminum against Fatty Acids at 80° to 100° C. Normal Operating Temperature. (Ueber die chemische Beständigkeit von Reinaluminium gegen Fettsäuren bei 80–100° C. betriebstechnischer Arbeitstemperatur.) WILLI CLAUS. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 44–47.

Chemical analysis, metallographic and technological tests proved that pure aluminum is practically entirely proof against attack by fatty acids both solid and liquid. A pure aluminum sheet would lose 1 mm. thickness only after more than 10,000 days. Ha(4)

Gmelin's Handbuch der anorganischen Chemie. Eisen. Part A (3). 8th edition. Verlag Chemie, Berlin, 1930. Paper, 7 × 10 inches, 273 pages. Price 40 RM.

This new installment of the volume on iron of Gmelin's Handbook of Inorganic Chemistry deals in 3 main chapters with the passivity of pure and technical iron, the chemical behavior and corrosion and the production of technical iron.

In particular, the first 2 chapters will be of interest for the modern metallurgist who has corrosion problems in his daily work. The first chapter on the passivity of pure and technical iron, written by one of the outstanding German experts in this field, considers the problem from a strictly scientific standpoint which makes it understood that the literature on the subject has been considered in a most comprehensive manner.

It was not possible to deal in this handbook with the corrosion problem from its manifold practical aspects on a large scale. Certainly the 3 authors of the chapter on "Chemical Behavior and Corrosion" have been wise not to do so, but to concentrate their efforts, in searching the literature, on the presentation of a picture which puts in the foreground the course of the reactions in corrosion attack. The difficulties in writing this chapter really seem to be insurmountable. Our gratitude goes to the authors who have done so well in managing them.

The last chapter on the production of technical iron contains one outstanding achievement, inasmuch as it deals in detail with the direct processes of steel making. There will be found the most complete review ever published on all of the many direct steel processes which have been suggested and tried in recent years. Not less than 87 pages are devoted to this subject.—G. Neuendorf (4)-B-

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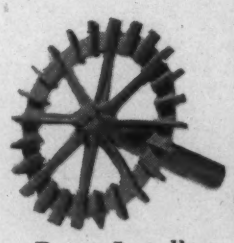

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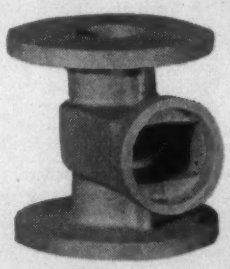

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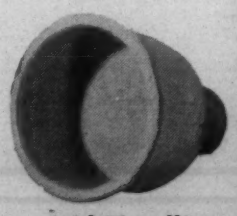

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Oxygen as a Factor in Submerged Corrosion. E. C. GROESBECK & L. J. WALDRON (Bureau of Standards). *Preprint* No. 45 for June 1931 Meeting, *American Society for Testing Materials*, 13 pages, 19 references.

Apparatus, wholly of glass and rubber, was used in which tap and distilled water of controlled oxygen content and controlled pH was circulated over the specimens. The pH was controlled by introducing CO_2 for the lower pH and by addition of a trace of NaOH for pH 8. Dissolved oxygen was varied from 1 to 25 cc./liter. Open hearth iron, 0.03% Cu; low carbon steel, 0.08% Cu; copper-bearing low carbon steel, 0.22% Cu; and open hearth iron with 0.43% Cu and 0.07% Mo were studied. The corrosion increased with increasing dissolved oxygen in tap water of pH 7.8 to 8.0. The Cu-Mo iron was not tested in this series. With oxygen above 5 cc./liter the copper-bearing steel showed an advantage, but, as in the case in practice with ordinary city, brackish and mine waters of lower than 5 cc./liter, had no appreciable advantage at lower oxygen concentration, though the corrosion was the less the higher the copper. With higher oxygen, the copper-bearing material was superior by a significant amount. In distilled water with varying pH and varying oxygen, the corrosion rate increased with increase in oxygen in water of pH 5 to 6. In that of pH 4.5, 7 and 8 it increased to a maximum with increase in oxygen and then decreased, apparently due to a passifying action. The materials with 0.22 and 0.43% Cu showed lower corrosion rates than those with lower copper. HWG(4)

Proper Care of Brine Aids Prevention to Corrosion. R. C. DOREMUS. *Heating, Piping and Air Conditioning*, Vol. 3, May 1931, pages 372–377.

Commercial zinc dust has been used to some extent as a corrosion retarder in sodium and calcium chloride brines. The pH value is maintained at 7.5 to 8.0 in such cases. If no zinc is present and the problem is simply to protect the iron and steel the pH should be kept around 9.0 to 9.5. The heavy brines have less corrosive effect on metals than the lighter ones. In sodium chloride brines the use of disodium phosphate (100 lbs./1000 ft.^{3}) reduces the corrosion from approximately 100 to 5%. The charge of phosphate must, however, be renewed once a month. This type of retarder is only practical in sodium chloride brines. Sodium chromate forms a retarder for either sodium or calcium chloride brines. Normal chromate is not easily obtained, therefore sodium dichromate is substituted. This is an acid forming chemical and therefore must be neutralized with alkali to form a neutral chromate and maintain a neutral brine condition. It is customary to use 100 lbs. of sodium dichromate and 35 lbs. of caustic soda/1000 ft.^{3} of brine. WAT(4)

Oxidation of Superheater Tubes by Pure and Impure Steam. (Oxydation der Ueberhitzerrohre durch reinen und unreinen Dampf.) R. STUMPER. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Feb. 1931, pages 41–43.

Tests on scaled superheater tubes are presented. Gives physical chemical ideas on the oxidation of iron by steam and the recent investigations made. Urges further research. MB(4)

Investigation at the Platinum-Hydrogen Electrode. (Untersuchung an der Platin-Wasserstoffelektrode.) M. THALINGER & M. VOLMER (Technische Hochschule, Berlin). *Zeitschrift für physikalische Chemie*, Sec. A, Vol. 150, Oct. 1930, pages 401–417.

The anodic behavior of a hydrogen electrode with bright platinum corresponds to that of metal electrodes as Fe, Cr, Ni, etc., which are subject to passification. The only difference is that the passification phenomenon concerns the hydrogen ions instead of the metal ions. The passivity proved to be a poisoning of the platinum surface by oxygen. The surface film cannot be identified optically. EF(4)

On the Corrosion Phenomena. Seventeenth Communication. Straumanis' Attempt to Interpret the Difference Effect. (Ueber Korrosionserscheinungen. 17. Mitteilung. M. Straumanis' Versuch einer Erklärung des Differenzeffekts.) A. THIEL (University of Marburg). *Zeitschrift für physikalische Chemie*, Sec. A, Vol. 151, Nov. 1930, pages 103–104.

Controversial criticism on Straumanis' interpretation of the phenomenon of the difference effect. EF(4)

Report of Committee A-5 on Corrosion of Iron and Steel. *American Society for Testing Materials, Advance paper* No. 13, June 23–27, 1930, 24 pages.

Composed of the report of Subcommittee III, on the inspection of Annapolis tests; of Subcommittee V, on total immersion tests; of Subcommittee VI, on specifications for metallic-coated products; and of Subcommittee VIII, on field tests of metallic coatings. (4)

Investigation of the Corrosion of Pure Aluminum and of Aluminum Alloys. (Untersuchungen über die Korrosion von reinem Aluminium und Aluminiumlegierungen). V. ZEERLEDER. *Korrosion und Metallschutz*, Vol. 6, Sept. 1931, page 206; *Genie Civil*, Vol. 98, Jan. 3, 1931, pages 12–13.

Refers to a paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. EF(4)

The Corrosion of the Tin-Plate Container by Food Products. *Department of Scientific Research, Food Investigation, Special Report* No. 40, 94 pages, price, 1s. 6d., net.

Corrosion is one of the main sources of deterioration and loss, for all classes of foodstuffs, whether fish, meat, vegetables or fruit, tend to attack the iron and tin of which the can is made. While the attack may be so severe as to cause actual perforation of the can by small pin holes, the heaviest losses are due to "hydrogen-swells" or "springers," as cans are called in which sufficient hydrogen has been evolved through corrosion to cause the ends to bulge outwards. A third effect of corrosion, and a very insidious one, for it cannot be detected until the can is opened, is discoloration, which may be serious in the case of certain meats, marine products and colored fruit. RR(4)

Cadmium and Zinc as Protection Agent. (Cadmium und Zink als Rostschutzmittel.) *Oberflächentechnik*, Vol. 8, Feb. 3, 1931, page 22.

A critical review of Dr. Patterson's paper on comparative resistance to corrosion of cadmium and zinc coatings exposed under equal conditions to various corrosion agents, which was published in *Chemical Age*, Vol. 23, No. 579, Metallurgical Section. The corrosion tests showed that cadmium as well as zinc, if the coatings are perfect, is suitable for inside-of-building purposes; they behave practically equally. Zinc is superior to cadmium under atmosphere corrosion (outside) and inside of buildings containing corrosive atmosphere. The steel involved contained 0.18% C and was electroplated in zinc sulphate and cadmium cyanide bath. ER(4)

Corrosion of Malleable Iron. F. W. WOLF & L. A. MEISSE (Ohio Brass Co.) in Symposium on Malleable Iron Castings. *Preprint* No. 30 for June 1931 Meeting, *American Society for Testing Materials*, pages 62–75.

Tensile specimens of basic open-hearth steel, ingot iron, wrought iron, all bare, malleable iron, bare and galvanized, and malleable iron with 1% Cu were exposed over 2 years in smoke jacks in a locomotive roundhouse. Comparing the round tensile bars after 25 months' corrosion, the strength in lbs./in.^{2}, figured on original area before corrosion, was ingot iron 27,000, wrought iron 29,000, galvanized malleable 35,000, bare malleable 38,000, bare malleable with 1% Cu 44,000, 0.26% O.H. steel 46,000. The steel started out with 66,500, the others with 45,000 to 49,000. The malleable with 1% Cu showed the lowest loss of strength or of weight. This was checked with another 19 month test on malleable without Cu, with 1/4, 1 and 2%. The attack decreases with increase in Cu up to 1%. Further increase to 2% brings no further advantage. In acid mine water, the higher the copper the worse the attack. HWG(4)

Pipe-Line Currents and Soil Resistivity as Indicators of Local Corrosive Soil Areas. E. R. SHEPARD. *Bureau of Standards Journal of Research*, Vol. 6, Apr. 1931, pages 683–708.

The present tendency in the protection of pipe lines against soil corrosion is away from a uniform coating for the entire length of the line and toward the application of coatings selected with respect to the corrosive character of the soils involved. This calls for a knowledge of varying soil conditions and a means of locating local corrosive soil areas. Such areas, commonly termed "hot spots," are prevalent in many types of soils and it is in these regions that pipe lines suffer the greatest deterioration. The location of such corrosive areas is a matter of considerable importance, both with respect to the selection of coatings for new pipe lines and the reconditioning of old ones. An extensive investigation on a dozen pipe lines ranging from the gulf coast to southern Kansas revealed an apparent correlation between pipe-line currents, soil resistivity and corrosion. Galvanic currents of measurable magnitudes were found to be flowing on all pipe lines examined. As a rule, lines were found to be collecting current in areas of normal and high soil resistivity and losing current in areas of low resistivity. Many cases of abrupt loss or discharge of current occurred in soils of unusually low resistivity. In such areas the pipe lines were found to be badly corroded. Although no direct relation was found to exist between electrical resistivity of soils and their corrosiveness, abrupt changes in resistivity and unusually low resistivity were found to be significant with respect to corrosion. Soils having a resistivity of about 500 ohm-cm. or less were invariably found to be highly corrosive. A better relation between resistivity and corrosiveness exists in alkaline than in acid soils. The technique of surveying pipe lines for galvanic currents is discussed and a piece of apparatus for simply and quickly measuring soil resistivity is described. (4)

Behavior of Sheets of Aluminum, Copper, Zinc and Iron in Contact with Wet Lithopones. (Verhalten von Blech aus Al, Cu, Zn and Fe in Berührung mit feuchter Lithopone.) *Report of the Material Testing Laboratory of the V. A. W., Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, page 52.

Pure aluminum was not corroded while all other materials showed very strong corrosion. The corrosion products were so firmly encrusted that the loss of weight could not be determined. Ha(4)

Corrosion and Metal Protection in Steam Power Plant Equipment. IV. (Korrosion und Metallschutz im Dampfkraftwerk.) R. STUMPER. *Korrosion und Metallschutz*, Vol. 7, Feb. 1931, pages 25–28.

A boiler tube failure from a gas fired furnace using a hard H_2O was investigated metallographically. A deposit of $CaSO_4$ was found to exist throughout the entire length of the tube. Sections of the tube were cut from the tube at the point of failure and at a point some distance from the blowout. Microscopic examinations of the metal surface of both sections revealed decarburization of the outer side of the section which failed, and indicated that the temperature of the inside of the tube had been between the Ac_1 and Ac_3 points, while temperature conditions in the other portions of the tube had apparently been such as to cause no changes in the microstructure. The conclusion was reached that localized overheating due to an impinging flame had caused the failure. (4)

New Method of Determination of Corrosion of Metal Sheets by Motor Fuels. (Neue Methode zur Feststellung der Korrosion von Metallblechen durch Motorenkraftstoffe.) WAWRZINIOK. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, May 1930, pages 65–69.

Liquids at rest attack metals differently from moving liquids. Tests to determine the corrosion in motor liquid fuels must, therefore, be conducted under proper motion. The test arrangement is described. The duration of the test should be from 15 to 30 days. The strongest action was exerted by distilled water, in which tin and aluminum showed up best. In absolute alcohol, brass and aluminum behaved the best. Ha(4)

Practical Methods in Corrosion Prevention. GUY V. THOMPSON. *Refrigerating Engineering*, Vol. 19, Mar. 1930, pages 87–90.

This paper recounts experiences in putting into application the reports of the Corrosion Committee of the American Society of Refrigerating Engineers. Disodium phosphate and zinc dust were used in ice plants where the cans were handled and sodium dichromate in closed systems and where the basket system of can removal was used. In treating a tank with disodium phosphate, the pH value was first adjusted slightly below the neutral point (HCl was used to reduce and caustic to raise the pH) and 100 lbs. disodium phosphate per 1000 cu. ft. sodium brine added. Although this treatment cleared the brine and gave considerable protection, it was necessary to renew the treatment every thirty days and if the brine for any reason gets above the neutral point, the treatment is of no value and the cans begin losing galvanizing and become heavily coated. Because of these difficulties of maintaining the treatment, it was discontinued. Zinc dust was tried (50 lbs. zinc dust/1000 ft.^{3} brine put in in a slurry) with the result that it cleared the cans, coils and tank from rust and scale as efficiently as the phosphate but did not give the protection desired. Sodium dichromate was then used on two New York A-P plants of 160 tons capacity. 100 lbs. sodium dichromate /1000 ft.^{3} calcium brine were added and the pH brought to 7.5 by the addition of caustic. It was found that the further addition of caustic to bring the pH to 9.5 as recommended resulted in precipitation and that the better figure was pH 7.5. About 95% protection was obtained. The use of sodium dichromate for open systems is subject to the danger of chrome itch but it was found that if proper cleanliness was observed, no trouble resulted, only one case of slight infection in twenty-four plants treated was obtained. Leakage of ammonia into the brine makes a very corrosive mixture for galvanizing and the author recommends throwing away the brine if very much acid is required to neutralize the ammonia. After treating 75 plants of various sizes and types since 1926, the author recommends 125 lbs. sodium dichromate/1000 ft.^{3} of calcium brine and 200 lbs./1000 ft.^{3} of sodium brine. A pH of 7 or slightly above is recommended. A high pH value attacks the galvanizing. A warm brine is corrosive and the treatment is added before any salt or calcium as otherwise the galvanizing would be attacked in spots. Corrosion prevention in ice plants is a question of local conditions and if trouble develops it is necessary to apply remedies immediately. In the discussion it was brought out that while sodium silicate will clear the brine it does not stop corrosion. VVK(4)

Preventing Scale Deposition and Corrosion in Boilers. *Industrial Chemist*, Vol. 6, Dec. 1930, page 494.

Notes on the methods and results of the N.O.C. process, by means of which scale can be removed in the form of flakes, or prevented from depositing, by means of a small current passed through the outer vessel. The cost of operation is about equal to that of burning one 100-watt lamp for each boiler, and the process is very efficient. MPB(4)

Stainless Steels for Automotive Parts. M. J. R. MORRIS. *S. A. E. Journal*, Vol. 28, Feb. 1931, pages 204–209.

Author shows that stainless steel should be divided into 3 classes, according to whether they are to resist corrosion under atmospheric, wet or heat conditions. Every trace of scale, iron oxide and contact with iron that might oxidize must be eliminated from the surface to prevent staining, which will extend far beyond the contamination. Basic compositions of steels in the 3 classes are tabulated, and the physical properties of a few of them are given. A bibliography of articles and books on stainless steels is appended. MFB(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Classifying Hardened Tool Steel Fractures. Correspondence from E. Oehman, Stockholm, Sweden. *Metal Progress*, Vol. 19, June 1931, pages 88–89.

Method of classifying and grading tool steel devised by Dr. Ragnar Arpi is briefly described. WLC(5a)

Etching Nickel and Its Alloys. W. A. Mudge. *Metal Progress*, Vol. 18, Dec. 1930, pages 72–73.

The author accompanies a description of flat and electrolytic etching reagents with 5 micrographs of nickel alloys showing the action of the reagents described. WLC(5a)

Constitutional Diagram Iron–Oxygen System. C. H. Mathewson. *Metal Progress*, Vol. 19, Apr. 1931, page 83.

A full page chart of this constitutional diagram is taken from the manuscript of a paper received Feb. 13, 1931, for the Transactions, "Evolution of the Iron-Oxygen Constitutional Diagram" by Mathewson, Spire and Milligan. WLC(5a)

Application of Cementation Methods of the Systems: Sb–Cd, Zn–Cd, Pb–Cd, Sn–Cd and Bi–Cd. Wl. Loskiewicz. *Przeglad Techniczny*, Vol. 69, June 25–July 2, 1930, page 508–513.

A cementation method as described elsewhere (Przeglad Gorniczo-Hurniczy, 1929, page 583) was employed in investigating the cementing characteristics of the systems Sb–Cd, Zn–Cd, Pb–Cd, Sn–Cd and Bi–Cd, on which cementation below the eutectic temperature forms permanent openings at the junction. By cementation at temperature above the eutectic temperature, the eutectic is formed followed by fusion at the junction, and therefore the absence of permanent openings. Tests carried out below the respective eutectic temperatures showed no evidence of cementation, while those cemented 3% above the eutectic temperature showed fusion and qualities of the eutectic. Methods employed are discussed. In the Sb–Cd system, CdSb is formed at the junction, while in the other systems investigated, eutectics were formed in every case. In the system Bi–Cd, there exists a fusion in a stable form and in the other systems, tests corroborate the existence of such fusion. GLC(5a)

A Note on the Constitution of the Cadmium-Zinc Alloys. D. Stockdale. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 75–82.

Includes discussion. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. (5a)

Microscopic and Thermal Investigations of Al-Sb-Mg Alloys. (Mikroskopische und thermische Untersuchung von Al-Sb-Mg-Legierungen.) E. Loofs-Rassow. *Aluminium, Hauszeitschrift der V. A. W. und Erftwerke A. G.*, Vol. 3, Jan.-Mar. 1931, pages 20–32.

Alloys of aluminum and manganese with additions of antimony have proven particularly resistant to sea water; their properties, however, have not yet become entirely known. The present investigation discusses first the binary systems Al–Mg, Mg–Sb and Al–Sb, and then the ternary system Al–Sb–Mg from which it can be concluded that the addition of Sb produces the formation of a new structural element Mg_3Sb_2, antimonide of magnesium, which is only slightly soluble in Al; with increasing temperature, the solubility increases. Tables and micrographs illustrate the results. Ha(5a)

On the Art of Metallography. Francis F. Lucas (Bell Telephone Laboratories, Inc.). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 421, 1931, 36 pages.

The Howe Memorial Lecture before the American Institute of Mining & Metallurgical Engineers, Feb. 1931. The first part of the lecture consists in a description of microscopic methods. It is pointed out that competent technicians as well as good equipment are necessary to obtain the full possibilities of the microscope. The objective is the most important part of the microscope. Methods for testing objectives are given. The structures of heat treated steels are discussed in the second part of the lecture, and the marked advances in the rendering of detail resulting from the authors work are described. Real images of detail that measure but a few hundred atom diameters have been developed, and clearly defined details of structure that are by actual measurement only a fraction of the wave length of the light used have been clearly defined. Numerous small cracks have been observed in hardened steels, and it is suggested that these cracks may account for the erratic fatigue results obtained with such steels. The cracks observed were as small as 2.86×10^{-3} in., which is only 16% of the dominant wave-length of light used. The measured length of the cracks ranged upward from 11.44×10^{-6} in. The minimum widths of the cracks were therefore of the order of 250 atom diameters. As a conservative estimate, the enlargement by etching was by a factor of 10, which means that the actual width of the smallest visible crack is probably of the order of 25 atom diameters. Contains 8 references. JLG(5a)

The So-Called Heterogeneity of Martensite. E. Maurer & G. Riedrich. *Iron Age*, Vol. 126, Dec. 11, 1930, page 1775.

Abstract translation of article in *Stahl und Eisen*, Oct. 9, 1930. Discusses the cause of irregular distribution of precipitated cementite in steels tempered at 1100° to 1200° F. See *Metals & Alloys*, Feb. 1931, page 34. VSP(5a)

The Kinetics of Recrystallization. (Zur Kinetik der Rekristallisation.) R. Karnop & G. Sachs. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 86–92; *Zeitschrift für Physik*, Vol. 60, 1930, pages 464–480.

Electrolytic Cu was cast, turned to a specimen with a conical section, annealed at 480° C. for 1/2 hour, stretched in a testing machine, and the reduction at various points measured, so as to give a specimen with a known graded degree to reduction (3 to 18%). The specimens were then annealed for various times at 284°, 341° and 370° C., and examined for recrystallization. At 370° C. it occurred in 2 minutes at 14% reduction, and in 800 minutes, at 3%. At 341° C. in 5 minutes at 14% reduction, and in 1000 minutes, at 5%. At 284° it took about 30 minutes at 18%, and over 1000 minutes at 11%. The curves for percentage reduction (cartesian scale) against annealing time in minutes (logarithmic scale) are almost a straight line for 284°, but slightly concave toward the percent reduction axis for the higher temperatures. Similar plotting of the rate of growth of grains during recrystallization gives again nearly a straight line for the lower temperature, and slightly curved ones for the higher temperatures. The growth of crystals in the recrystallization of Al was similarly studied. Various mathematical expressions are given for the kinetics involved, for which the original should be consulted. HWG(5a)

Polishing Procedure for Minerals. (Aus der Praxis des Erzanschliffes.) Werner Gründer. *Metall und Erz*, Vol. 28, March 1931, pages 143–147.

Contains 2 references. A detailed procedure is described for polishing specimens of minerals and coal for microscopic examination. A flat specimen is preferable to one polished in relief. Rough grinding is done on No. 80 or No. 200 carborundum at 1600 r. p. m. for 5 to 10 minutes. It is better not to grind the edges of minerals, as most of them are brittle and are liable to crack. The second step is polishing on emery paper mounted on a disk revolving at 500 to 800 r. p. m. This operation should take about 1 hour. Good results are obtained by wetting the specimen with a mixture of 4 drops water, 7 cc. lubricating oil and 5 g. emery. In this case the disk speed should be 300 r. p. m. The specimen is then washed with xylol or toluol. Final polishing is done on billiard table cloth at 500 r. p. m. using a mixture of 1 part MgO and 3 parts Al_2O_3. The specimen should be turned constantly during polishing. Eight photomicrographs are given. CEM(5a)

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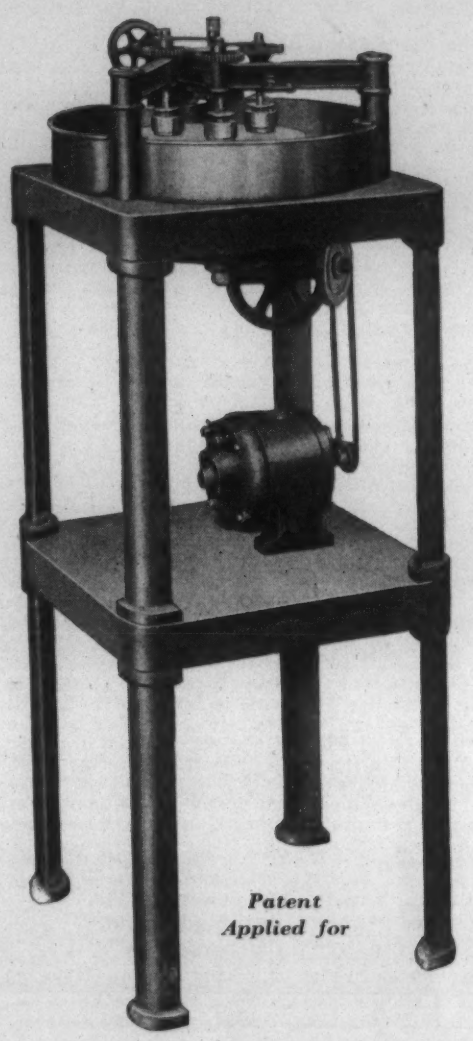

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THIS new machine is based upon a similar one, developed by the U. S. Bureau of Standards' engineers, to effect a standardization of methods employed in polishing specimens for microscopic examination. To their design we have added several improvements of our own and can now supply the machine as pictured above, ready for use in the laboratory. It produces a remarkably high polish, free from pits and "comet-tails", such as occur on specimens that are hand polished and showing perfect formation of inclusions, with practically no rounding-off of edges of the cracks. It accomplishes this automatically, polishing three specimens at the same time, without requiring the constant attention of a high-salaried technician. This new machine will very quickly save many times its cost in any metallurgical laboratory. A bulletin describing it in detail will be sent to you promptly, upon request.

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The Macroexamination of Steel. M. G. Yatsevitch. *Army Ordnance*, Vol. 11, Jan.-Feb. 1931, pages 297–305.

This 7200-word article almost amounts to a text book—brief but up-to-date. Thorough discussions on preparation methods, consideration of objects of tests, etc. Examples given. Three excellent tables on quantity of reagents, etching times, etc. Discussion of interpretation of picture revealed on surface of metal. MFB(5a)

Thermal Analysis and Dilatometry. H. Scott (Westinghouse Elec. & Mfg. Co.). *First Communications of the New International Association for the Testing of Materials.* Group A, Zurich, 1930, pages 339–344. 14 references.

General discussion of the applicability of thermal analyses, dilatometry and magnetic and electrical methods to metallurgical problems. HWG(5a)

Critical Ranges in Pure Iron-Carbon Alloys. The A_3 and A_{cm} Ranges, and the Merging Point of A_3 and A_2. R. H. Harrington (General Electric Co.) & W. P. Wood (University of Michigan). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 632–658.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion, 13 references, 24 micrographs. 32 steels prepared by the methods of E. D. Campbell of 0.000–1.500% carbon. Diagrams show the critical points obtained on heat treated specimens, on cooling specimens, and an average of the 2 curves. Space diagrams showing the possible rearrangements when γ iron changes to α are given. 6 critical curves are shown representative of the carbon range studied. WLC(5a)

The Electrolytic Decomposition of Cementite and Austenite. H. A. Schwartz, G. H. Guiler & H. H. Johnson (National Malleable and Steel Castings Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 718–728.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion and three references. Compositions and nature of the electrolytic residues from cementite and austenite are studied and discussed. WLC(5a)

A Study of the Tungsten-Carbon System. W. P. Sykes (Cleveland Wire Works, General Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 968–992.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion and is illustrated with 27 micrographs and 6 X-ray spectrum, 5 references. The author presents a tentative constitutional diagram of the system tungsten-carbon for the tungsten rich end, up to 11% carbon. WLC(5a)

A Thermodynamic Study of the Equilibria of the System Antimony-Bismuth and Antimony-Lead. Chu-Phay Yap. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 397, 1931, 24 pages.

A thermodynamic study of the Bi-Sb system indicates that the horizontal position of the solidus as determined by thermal methods may result from the reaction $\beta(Sb_2\text{-}Bi_3) \rightleftharpoons \alpha(Sb_2\text{-}Bi_2)$, these expressions indicating solid solutions. The formation of the phase Bi_3 in solid solution in Sb_2 may result from a peritectic reaction. The heats of fusion of Bi and Sb are calculated as being 14.2 and 20 cal./g., respectively. Analysis based on the variation of solid solubility of Sb in Pb and the slope of the liquidus and solidus indicates that the Sb in solution in the lead suffers an allotropic transformation at about 150° C. It appears that in the liquid lead-rich solution Sb is monatomic, and that in the solid solution above 150° C. it is diatomic, while below this temperature it is monatomic. Contains 14 references. JLG(5a)

Progress of Microscopy. H. Wrighton (Woolwich Arsenal, England). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 366–368.

Very brief reference to recent British advances. HWG(5a)

Fundamentals for the Use of Alloyed Steels. R. Whitfield. *Iron & Steel Industry & British Foundryman*, Vol. 3, Aug. 1930, pages 347–350.

The influences of alloy additions upon the transformation point and the properties of pearlitic, troostitic, martensitic and austenitic steels are discussed. CHL(5a)

Thermal Analysis of Iron-Manganese Alloys. F. M. Walters, Jr. & Cyril Wells. *Mining & Metallurgical Investigations U. S. Bureau of Mines & Carnegie Institute of Technology, Mining & Metallurgical Advisory Boards*, 4th Open Meeting, Oct. 17, 1930, 6 pages.

Thermal analyses were made in a gradient furnace on Fe-Mn alloys containining 1.7, 4.4, 7.2, 10.2, 13.1 and 16% Mn with an average of 0.02% C. A sudden change in thermal disturbance was observed in alloys containing 13 and 16% Mn. (5a)

Influence of Nickel on the Chromium-Iron-Carbon Constitutional Diagram. V. N. Krivobok & M. A. Grossman. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 808–836.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion and 3 references. The paper is amplified by 29 micrographs, and numerous diagrams and figures. The extent to which nickel widens the austenite field is illustrated in analogues of iron-carbon diagrams, the "iron" being an alloy with 18% chromium and the added nickel. Nickel widens the range of temperature in which austenite is stable, the range of carbon content in which it is stable is also widened and the carbon range where ferrite and austenite together are stable is narrowed. Magnetic and hardness data are given with a discussion of the precipitation of the carbides at 1200° F. WLC(5a)

Austenite Decomposition and the Change in Magnetic Properties. Harley S. Van Vleet & Clair Upthegrove. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 729–759.

Manuscript received July 29, 1930. 12 references to the literature. The authors have investigated the relation between magnetic properties and retained austenite in 5% tungsten magnet steel. The austenite was decomposed by tempering and by quenching in liquid air. The findings show that more austenite was retained in the specimens quenched from higher temperatures indicated by the greater density change upon quenching and by the secondary hardness effect during tempering. Bars show decreasing density with more drastic quenching medium. A tempering range of 977–1121° F. most readily decomposed the austenite. The effect of the two methods of decomposing the austenite on the physical and magnetic properties are:

Property	Tempering	Liquid Air Treatment
Density	decrease	decrease
Hardness	increase	decrease
Maximum induction Bm	decrease	increase
Residual induction Br	increase	increase
Coercive force Hc	increase	decrease
Product Br × Hc	increase	increase
Quotient Br/Hc	decrease	increase
Maximum of permeability B/H	decrease	increase

WLC(5a)

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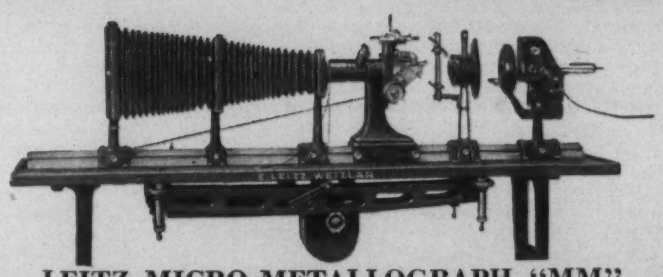

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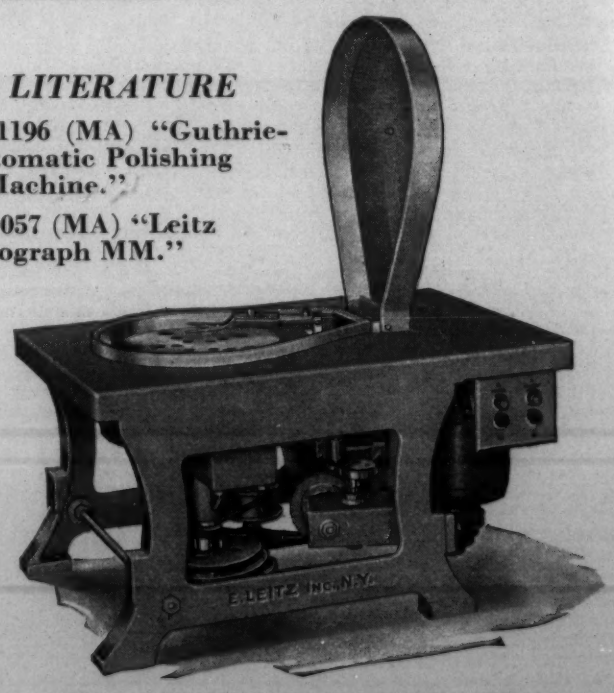

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STRUCTURE OF METALS & ALLOYS (5)

Structure & X-ray Analysis (5b)

X-ray Investigation on the System Sulphur–Selenium. (Röntgenographische Untersuchung im System Schwefel-Selen.) F. HALLA & F. X. BOSCH (Technische Hochschule Vienna). *Zeitschrift für Physikalische Chemie*, Sect. B, Vol. 10, Oct. 1930, pages 149–156.

The most important data concerning the structural arrangement of the rhombic solid solutions of Se and S were determined by X-ray investigation. EF(5b)

X-Ray Studies of Quenched Steels. Correspondence from A. WESTGREN (Stockholm). *Metal Progress*, Vol. 19, Mar. 1931, pages 87–88.

The writer describes technique and results of X-ray studies of Öhman at University of Stockholm in analyzing the tetragonal phase in quenched carbon steel. WLC(5b)

Suppressions in Alloys of Manganese. Correspondence from A. WESTGREN (Stockholm). *Metal Progress*, Vol. 19, Feb. 1931, pages 86–87.

The writer reports with diagrams certain complex tendencies noted in an X-ray study of systems Fe–Mn and Cu–Mn by Öhman and Persson at the University of Stockholm. WLC(5b)

X-Rays Detect Twin Crystals in Alpha Iron. N. P. Goss (American Steel & Wire Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1238–1245.

Three references are cited. Previously it was found that low carbon steel drastically cold-rolled and heat treated showed a new orientation developed during annealing. This study shows what conditions of cold work and heat treatment are necessary to develop this new orientation. WLC(5b)

X-Ray Investigation of the System Sulphur–Selenium. (Röntgenographische Untersuchung im System Schwefel-Selen.) F. HALLA, E. MEHL & F. X. BOSCH. *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 12, May 1931, pages 377–386.

Space lattice and pattern of mixed crystals of Se and Te were determined by X-ray investigation. The unit cell contains 32 atoms and yielded the following parameters: $a' = 8.48$ A. U., $b' = 13.34$ A. U., $c' = 8.33$ A. U. and $\beta = 67° 30'$. The density = 2.833. EF(5b)

X-Ray Testing of Large Boilers in Service. (Röntgendurchstrahlung im Grosskesselbetrieb.) A. HERR. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Oct. 11, 1930, pages 1432–1433.

An arrangement is described whereby large tanks, drums, etc., are tested by X-rays on site. The X-ray tube is installed in the interior and exposures on films taken on the outside. One exposure lasted 30 min. at 145 KV. The films were 15 × 40 cm. Ha(5b)

Space Lattice of Cementite. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 18, Nov. 1930, pages 87–88.

Dr. Honda reports determinations of Fe_3C space lattice dimensions by Shimura at Tokio as, a = 4.511, b = 5.047, c = 6.738 A. U. Diagram is given. Fe_3C has a simple orthorhombic lattice with 4 molecules to the cell. WLC(5b)

X-Ray Inspection of Welded Pipes and Pressure Equipment. H. R. ISENBURGER. *Heating, Piping and Air Conditioning*, Vol. 3, April 1931, pages 304–305.

With the growing use of welded materials in high-pressure, high-temperature services the need for a means to prove the soundness of the structure appeared. X-rays are being used to meet this need. The article describes the set-up and shows photographs of the results obtained. WAT(5b)

X-Ray Examination of Steel Gas Flasks. (Röntgenprüfung von Stahlgasflaschen.) C. KANTNER. *Autogene Metallbearbeitung*, Vol. 23, Oct. 15, 1930, pages 317–324.

The continuous examinations of steel flasks for gases during their manufacture and the equipment necessary are discussed. Tests are described and economy investigated. Numerous photographs of X-ray pictures illustrate the defects found in finished flasks. Continuous supervision of the filled flasks by means of X-ray is found to contribute to the safety of plants and storage. The cost of the examination for one flask, including materials, amortization of equipment, electrical energy and overhead, were, in one case, found to be Mk. 2.38 ($0.59). Ha(5b)

X-Ray Testing of Compressed Gas Flasks. (Röntgenprüfung von Druckgasflaschen.) C. KANTNER & A. HERR. *Autogene Metallbearbeitung*, Vol. 24, June 1, 1931, pages 167–171.

Continuing a previous investigation, additional material has been collected to show defects in manufacture and violations of rules in manufacturing. A portable installation for shop tests is described. The whole X-ray outfit costs RM 6500; 15 flasks could be tested in one hr., including the taking of 15 exposures. The expenses for the testing of one flask amounted to RM 1.43, inclusive of films and chemicals. Ha(5b)

X-Ray Investigation of Coagulation Phenomena of Colloidal Gold. (Röntgenographische Untersuchung des Koagulationsvorganges bei kolloidalen Gold.) P. SCHERRER & H. STRAUB. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 154, May 1931, pages 309–321.

The coagulation of highly dispersed gold solutions is investigated by means of X-rays and the conditions were established leading to collective crystallizations of the primary particles. The effect of inhibitors was furthermore studied. EF(5b)

X-Rays in the Steel Industry. H. H. LESTER (Watertown Arsenal). *Journal of the Franklin Institute*, Vol. 211, May 1930, pages 567–579.

General discussion. Increasing demand for better steels will be met largely by improvements resulting from basic information obtained by means of X-ray diffraction studies. X-ray inspection eliminates unsound metal and aids in developing manufacturing technique that will produce sound metal. MS(5b)

Radiography by the Use of Gamma Rays. R. F. MEHL, G. E. DOAN & C. S. BARRETT. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1192–1237.

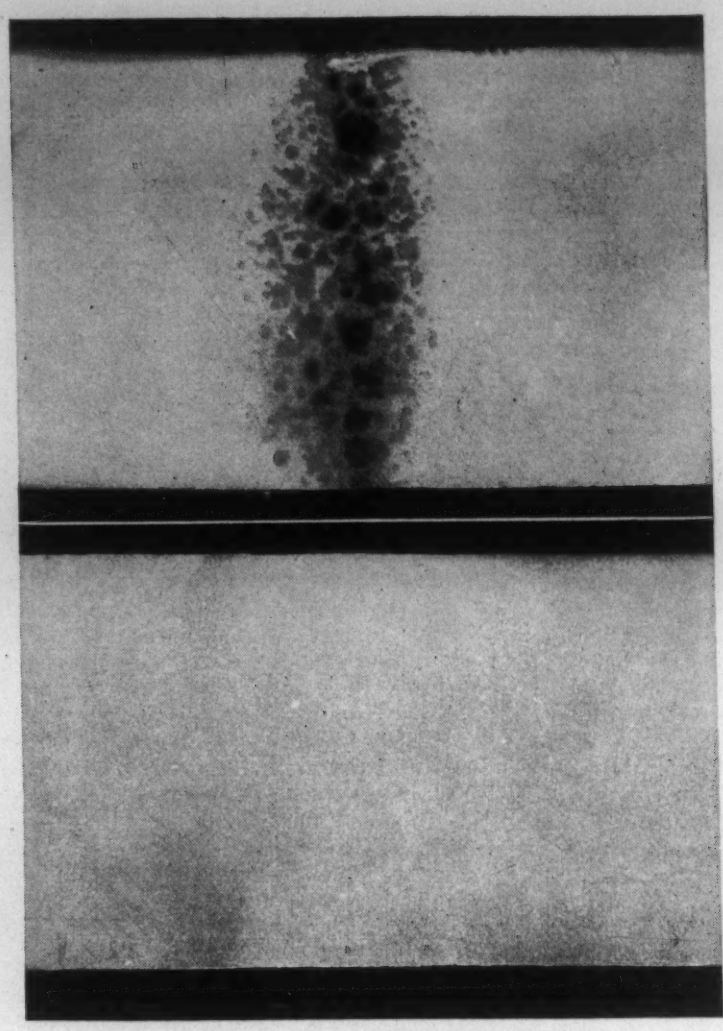
Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion, and 12 references. The authors detail the technique developed for the use of γ-rays for the radiography of much thicker steel specimens than it is possible to examine with ordinary X-rays. The technique and results presented are discussed. WLC(5b)

X-Ray Study of Grain Size in Steels of Different Hardness Values. W. A. WOOD. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Dec. 1930, pages 1073–1081.

Measures the broadening effect of 10 samples of stainless steel having the same chemical composition but of different hardness. Discusses the relation between measured grain size and hardness. Hardness varies inversely as the superficial area of the grains. RHP(5b)

Crystal Structure in the System Copper–Bismuth. WILLIAM F. EHRET & RAY D. FINE. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Oct. 1930, pages 551–559.

A series of alloys from pure Cu to pure Bi was examined as to structure. All the alloys examined were heterogeneous, showing clearly the superimposed patterns of Cu and Bi. The lattices of Cu and Bi remained unchanged in their alloys. This indicates very low mutual solubility. The lattice constant of the face-centered unit cube of Cu is $A_0 = 3.607 \pm 0.004$ A. U., and Bi 4.749 ± 0.005 A. U. RHP(5b)



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The procedure usually followed is to increase the blank holder load using blanks of the same diameter until failure occurs.

While it may be possible that two sheets can be drawn from the same maximum diameter, one of them may stand a higher blank holder load than the other. This one would have to be called the better sheet for drawing purposes.

If the two sheets mentioned would, however, show failure at exactly the same blank holder loads there is still a chance of differences in deep drawing forces. It seems logical to call that one the better sheet which requires smaller drawing forces to give the same cup under identical conditions.

◆ ◆ ◆

Nickel Manganese Steel Welding Rod

The following claims are made for the AMSCO Nickel Manganese Steel Welding rod:

Perfect welds can be made by relatively unskilled operators. When the rod is melted in the atmosphere and applied to ferrous metal articles, it exhibits the essential characteristics of standard heat treated manganese steel, namely toughness, ductility, resistance to abrasion and hardening under cold working.

The high nickel content (approximately 5%) overcomes any tendency of the metallic manganese content of the rod to oxidize and prevents embrittlement under slow cooling, which the rather high carbon content might cause in the absence of the high nickel content.

The patent claims granted on this welding rod are very broad covering ranges of all principal elements as follows:

Iron	90.00% to 25.00%
Manganese	5.00% to 25.00%
Carbon	0.50% to 2.00%
Nickel	0.25% to 50.00%

The preferred formula designated as "A" in the patent is as follows:

Iron	about 80.00%
Manganese	14.00%
Carbon	1.30%
Nickel	5.00%
Silicon	0.35%

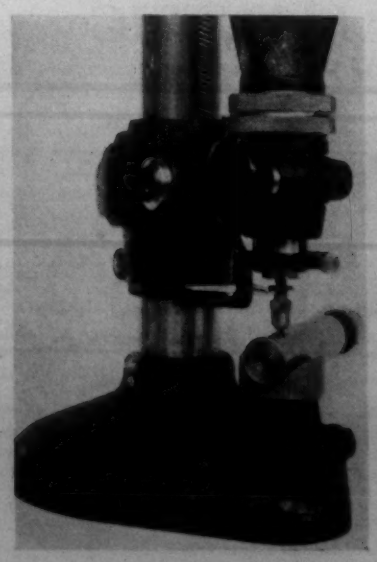
This may be compared with an actual analysis taken of a recent rolling of a carload of AMSCO Manganese Steel welding rod now in stock:

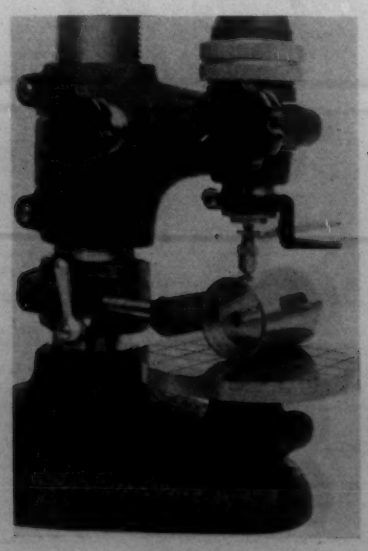
Iron	about 80.00%
Manganese	13.72%
Carbon	1.22%
Nickel	5.00%
Silicon	about 0.50%

◆ ◆ ◆

Micro-Indicator Stand with Vee-Block Table

A modification of their Micro-Indicator Stand U-3 is being offered by the Société Genevoise d'Instruments de Physique through their agents, the R. Y. Ferner Company, Investment Building, Washington, D. C., in which a vee block is furnished as the table, adapting it to the support of small cylindrical pieces, from $^1/_8$" to 2" in diameter, as shown at left of illustration, for the measurement of their diameter or roundness.





Larger pieces, up to a maximum of 6" in diameter, can be checked on a large flat table $4^1/_8$" diameter as shown at right. This table is case hardened and lapped and is provided with cross grooves to eliminate dust on the surface and provide for a good contact with the standard flat gage blocks when they are wrung onto it to establish the zero setting of the instrument.

An adjustable square is also furnished, for attachment to the column of the stand, which serves as a stop piece against which cylindrical test pieces can be rolled to the correct position for reading on their diameter. The micro-indicator used in these measurements has adjustable tolerance marks which can be set at any desired point up to .003" either side of the zero. The indicator is also provided with a lifting clip by which the contact plunger can be raised for the insertion of the work piece beneath the spherical or flat contact anvil without the necessity of rolling or sliding the piece under the anvil each time with resulting wear of the contact surface. These facilities make rapid inspection of parts an easy matter.

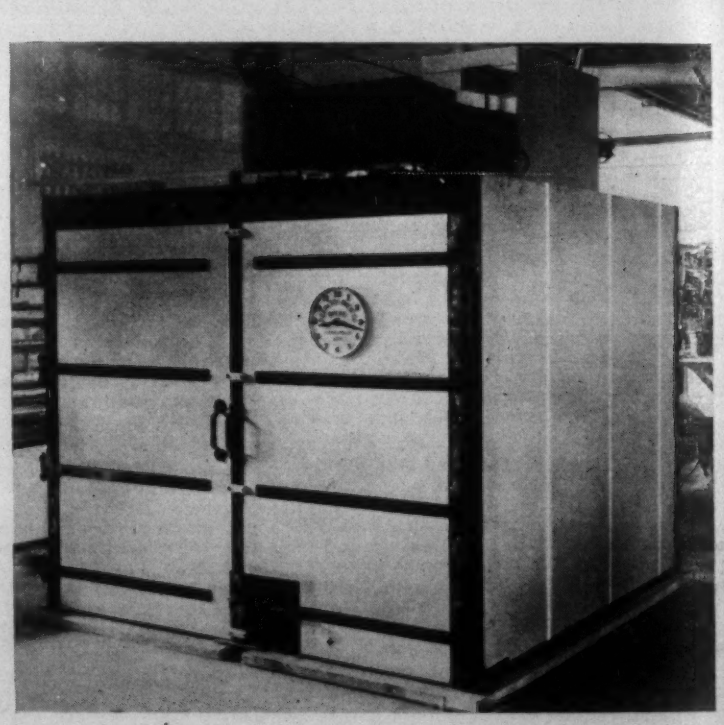
The micro-indicator can be supplied graduated to $^1/_{2000}$, $^1/_{5000}$, $^1/_{10,000}$ or $^1/_{20,000}$ inch per division according to the grade of accuracy demanded. The instruments are guaranteed to read accurately to 1% of the total range of the dial which varies from .02 to .006 inch according to the manner of graduation.

◆ ◆ ◆

New Normalizing Oven

Normalizing sylphon devices has presented a serious and intricate problem to manufacturers for many years. Many types of ovens, including crude homemade equipment, have been used without success.

While uniformity seemed apparent, the sylphon switches in operation gave very unsatisfactory service. Stresses and strains had not been properly removed in the normalizing process.



Recently, a midwestern electric refrigerator manufacturer selected the type S oven of the Despatch Oven Co., Minneapolis, Minn., which has an electric heating system externally mounted, and a recirculating ventilating system.

The oven has sufficient capacity for 1800 sylphon units at one time which are loaded on trucks and pushed into the oven. After parts are in the oven at a constant temperature for a sufficient length of time, they are removed. Normalizing is done uniformly and quickly.

The oven is a new development for this type of work. It has the double wall panel construction with highly efficient rockwool insulation between. Oven can be knocked down and moved whenever desired.

A 6 k.w. heating system is mounted in a separate chamber on top of the oven. An electric fan forces air through this heater and down into heat ducts in the oven. By proper graduation of ports in the ducts correct distribution of the heat is secured.

The air is then uniformly circulated around the parts in the oven by means of a recirculating ventilating system. Other ducts, properly located in the oven and also graduated, are interconnected with the electric fan which forces air through the heater. By this system, the temperature in the oven is maintained within ± 4° F. in all parts and normalizing is uniform and thoroughly done.

(Continued on Page 233)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Magnetic State of Platinum. (**États magnétiques du platine.**) P. COLLET & G. FOËX. *Comptes Rendus*, Vol. 192, Apr. 20, 1931, pages 930–932.

Collet and Foëx describe the results of tests on 4 samples of platinum, which were apparently identical in character when otherwise examined but which showed distinct differences in the magnetic state when tested by magnetic measurements of the highest precision. In particular, reference is made to a change in magnetic state at a temperature about −110° C. This particular sample of platinum in the initial series of experiments gave a value of 12 magnetons, a value which was never reproduced in subsequent experiments. OWE(6)

Electrical Testing of Materials without Destruction of the Material Tested. (**Werkstoffprüfung mit Hilfe des elektrischen Stromes ohne Zerstörung des zu prüfenden Werkstoffes.**) M. FINK. *Organ für die Fortschritte des Eisenbahnwesens*, Vol. 85, July 1930, pages 329–332.

Refers to the testing method of Sperry, The method, developed in the U. S. A., is described at length and illustrated. EF(6)

The Microcharacter. CHRISTOPHOR H. BIERBAUM (Lumen Bearing Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930 pages 1009–1025; *Metal Progress*, Vol. 18, Nov. 1930, pages 42–44.

Paper presented before the Twelfth Annual Convention of the Society Chicago, Sept. 1930. Includes discussion the author describes his "Microcharacter hardness tester" used for testing the hardness of small areas and very thin sections. Method of operation is detailed and curves are shown of results on nitrided and carburized cases. WLC(6)

Stresses in Fillets. E. F. GARNER. *Product Engineering*, Vol. 2, June 1931, pages 259–261.

Concentrated stresses in fillets may cause the birth of "fatigue cracks," especially in brittle materials. Even low-carbon steels subjected to vibratory stresses may fail because of high stresses in small fillets or sharp corners. Curves and tables are given for the calculation of the stresses. This calculation is illustrated by an example. Ha(6)

Endurance of Electroplated Parts Studied. Correspondence from C. H. DESCH, Sheffield, England. *Metal Progress*, Vol. 19, Apr. 1931, pages 92–93.

Notes on the effect of electroplating various metals on the fatigue resistance of the plated parts. WLC(6)

Torsional Testing of Wire. ALEX. GLAZUNOV. *Wire & Wire Products*, Vol. 6, Apr. 1931, pages 130–131, 149–150.

The importance of the torsional test for wires is pointed out as being greater than bending or tensile tests. The following suggestions are submitted: (1) The torsion or twisting test shall be considered as important in the selection of wires for specific purposes. (2) An optional minimum of twists shall be adopted for particular grades of wires. (3) The load under which the number of twists is to be determined shall be expressed in % of the average of the actual tensile strength for each grade of wire under examination. (4) The testing load for torsion shall be conventionally 1, 2 or 3% of the actual tensile strength of the wire. (5) The ruptured end of the tested specimens shall be smooth and the distribution of twists over the entire length of the sample shall be absolutely uniform. A testing machine is described and convenient dimensions for sample and load proposed. Curves and tables show the relation between load and number of twists until rupture occurs. Ha(6)

The Notch Toughness of a Few Aluminum Alloys Especially at Low Temperatures. (**Ueber die Kerbzähigkeit einiger Aluminiumlegierungen insbesondere bei tiefen Temperaturen.**) W. A. GÜLDNER. *Zeitschrift für Metallkunde*, Vol. 22, Dec. 1930, pages 412–416.

Conclusion of previously published article (See *Metals & Alloys*, Vol. 2, Feb. 1931, page 37). The influence of velocity of test, of the width of the test piece, and of the depth of the notch, all at −190° C. was studied. The relations between these conditions is exposed mathematically and graphically, and discussed at length with comparison to Fe alloys. RFM(6)

Testing of Materials, Principles and Recent Research Results. (**Ueber die Prüfung der Werkstoffe, Grundsätzliches und neuere Forschungsergebnisse.**) OTTO GRAF. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 2, 1931, pages 537–542.

A general discussion of short-duration tests for determining the guarantees given for building materials, steel, concrete, wood. All tests should follow, as closely as possible, actual service conditions. 25 references are given. Ha(6)

Stress Distribution in Bolted Structures. (**Ein Beitrag zur Frage der Spannungsstörungen in Bolzenverbindungen.**) G. BIERETT. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 15, 1931, pages 3–39.

Tests of stress distribution about bolt holes and elsewhere in a large eye-bar for a bridge. The highest load applied was about 11,000,000 lbs. Higher stresses than the tensile strength of the material in ordinary tests can be resisted, if plastic deformation is hindered. Failure depends on the "Trennfestigkeit" of the material as well as its tensile strength. The maximum unit load resisted by the eye-bar was equivalent to the tensile strength of the steel after stretching 18%—i. e., the effective strength was 16% higher than that of the original annealed steel in the tensile test. HWG(6)

On the Effect of Cold-Working on the Density and Electric Resistance of Metals. T. UEDA. *Kinzoku no Kenkyu*, Japan, Feb. 1931, pages 53–71; *Science Reports of Tohoku University*, Vol. 19, 1930, pages 473–498.

Specimens of steel, copper and brass, 5 mm. in diameter and 200 mm. in length were annealed thoroughly. They were stretched by testing machine and electrical conductivity was measured in machine oil. Density was calculated from the external force applied. The results were as follows: The density gradually decreases with the increase of stress, and its rate is constant up to the yield point, beyond which it rapidly increases. The discontinuous decrease of density at the yield point decreases as the carbon content increases, and almost vanishes at 0.9% C. This is due to the decrease of plasticity with the carbon content, or the formation of minute cavities caused by internal slipping is not so great as in the case of low carbon steels. In the case of copper and brass, the density decreases almost linearly to the yield point and then rapidly decreases. The cause of these changes may be explained in the same way as in the case of carbon steels. The specific electrical resistance of Armco iron and 0.2% carbon steel increases linearly up to the yield point, at which a discontinuous increase of resistance is observed, and afterward, it increases linearly. As the content of carbon increases, the increase of the specific resistance below the yield point diminishes, and at that point the specific resistance decreases instead of increasing as in the former case. Beyond the yield point, the specific resistance increases but the total increase becomes less as the carbon content increases. The initial increase of specific resistance is due to the decrease of free electron caused by the decrease of density by applied force. The rapid increase above the yield point is principally due to the minute cavities in metals. In low carbon steels, the specific resistance abruptly increases and in high carbon steels, abruptly decreases at the yield point. This phenomenon is explained as follows: At the yield point, the metal undergoes a great amount of internal slipping, this causing minute cavities and resulting in an increase of resistance. On the other hand the yielding reduces the initial strain and causes a decrease of resistance. Thus, during the yielding, two opposite effects on the electric resistance are concurrent. In low carbon steels, the initial slipping is considerable and the specific resistance increases; in high carbon steels, the internal slipping is not caused so freely and hence the resistance decreases. KT(6)

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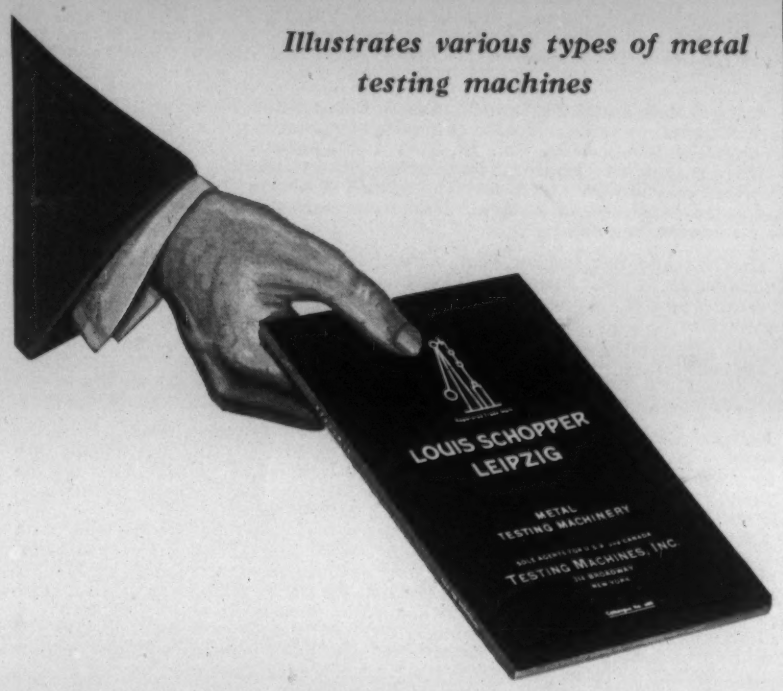

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Wear Resistance of Nitrided Nitralloy. V. O. Homerberg & J. P. Walsted. *Metal Progress*, Vol. 18, Dec. 1930, pages 68–71.

Wear is defined and its nature analyzed. An apparatus for wear testing is described. Tests of nitralloy against itself, gray cast iron, white cast iron, Monel and 3 bronzes were made. Results indicate great possibilities for nitrided material in machine and engine parts subject to severe conditions of wear or difficult to lubricate. WCL(6)

Sharpness Tests for Different Razor Blades. Correspondence from K. Honda, Sendai, Japan. *Metal Progress*, Vol. 19, Mar. 1931, pages 88–89.

The writer describes equipment for testing sharpness of razor blades and gives results of such tests on 21 blades made in 6 different countries. WLC(6)

Aging Notch-Toughness and Etching of Force-Effect Figures. (Alterungskerbzähigkeit und Kraftwirkungsfiguren-Aetzung.) H. Jungbluth. *Krupp'sche Monatshefte*, Vol. 12, May 1931, pages 106–112.

More recent investigations have proved the reliability of the theory that a certain relation exists between the figures of action of force and the aging and notch-toughness of a steel. Numerous tests are described in detail and 26 references are cited. Ha(6)

The Notched-Bar Impact Test, a Further Résumé in the Light of Present Knowledge. J. M. Lessells, Chairman A. S. T. M. Sub-Committee on Impact Testing. Appendix IV to *Preprint* No. 4, Report of A. S. T. M. Committee E-1 on Methods of Testing for June 1931 Meeting, *American Society for Testing Materials*, 3 pages, 4 references.

The ability of the impact test to reveal faulty material is now evident. The results of Mailänder and Moser on effect of dimensions of test specimen are briefly discussed. HWG(6)

Fatigue Tests of Low-carbon Steel at Elevated Temperatures. Progress Report. H. F. Moore & N .J. Alleman (Univ. of Illinois). Appendix 1 to Report of Joint Research Committee on Effect of Temperature on the Properties of Metals. In *Preprint* No. 29 for June 1931 Meeting, *American Society for Testing Materials*, 8 pages, 3 references.

Fatigue tests were made on a normalized 0.17% C, 0.42% Mn steel in a rotating spring testing machine at 550°, 800° and 1200° F., at 2500 and 200 r. p. m. Creep tests on this material were reported previously by Kanter and Spring (Proceedings A. S. T. M. Vol. 30 Pt. I, 1930, page 110). The test at 550° F. gave a clearly-marked endurance limit at 39,000 lbs./in.², well above the 30,000 lbs./in.² found in room temperature tests. At 800° F. the endurance limit was not determined, fracture occurring in 100 million cycles at 2500 r. p. m. at 28,000 lbs./in.². Under these conditions at 200 r. p. m. fracture occurred in a few million cycles. Time occupied by the endurance test rather than the number of the cycles of stress seemed to determine failure. At 1200° F. fractures occurred at 6000 lbs./in.², in the endurance tests no endurance limit was obtained and time was again the important factor in failure rather than number of cycles. The stresses at which failure occurred at 800° and 1200° F. were higher than the stresses for 1% flow in 10,000 hrs. in a static creep test. It seems probable that at 800° F. or above, the criterion for failure is the rate of creep rather than the fatigue properties. Details of the apparatus and methods used are given. The work is not yet complete. HWG(6)

The Significance of Crystal Structure for the Evaluation of the Elastic Limit and Fatigue Strength of Elektron Metal. (Die Bedeutung des Kristallaufbaues für die Beurteilung der Elastizitätsgrenze und Dauerfestigkeit von Elektron Metal.) W. Schmidt. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 54–57.

It is pointed out that since Mg (or Elektron Metal) is hexagonal in structure its yield point will be much more affected by crystallite orientation than that of cubic metals. Unpublished research by E. Schmid and G. Siebel has shown that *the threshhold shearing stress for slip in a pure Mg single crystal is 0.116 kg./mm.²*. If, however, the metal lattice in the single crystal is so oriented that the plane of slip is perpendicular or parallel to the direction of tension *fracture without elongation takes place at 7–9 kg./mm.²*, a 4000–5000% greater tension. Upon elongation Mg thus slips at a low stress, but rapidly hardens until finally the strengthened crystallites are all similarly oriented for slip. The behavior of Al is fundamentally different, a difference of only 85% between easiest slip and fracture obtaining. Al possesses the possibility of slipping in several planes and thus but little reorientation on deformation is necessary to make the deformation nearly uniformly distributed among the crystallites. The tension-elongation diagram for Mg (Elektron Metal)—thus shows a low elastic limit with the stress rising rapidly from 6 kg./mm.² at the elastic limit to approximately 21 kg./mm.² at an elongation of 0.05% and slowly thereafter, whereas with Al (duralumin) the stress rises slowly from 17 kg./mm.² at the elastic limit to 21 kg./mm.² at an elongation of 0.05%, and thereafter runs parallel to the curve for Mg. It is pointed out that any chosen conventional limit of elongation for the yield point in these two metals is artificial and useless, and that the whole stress-elongation diagram should be considered. An example is given in the design of a turbine bracket wheel of Elektron Metal. The importance of fatigue and of the mechanical hysteresis loop is emphasized. Hysteresis loops are given for duralumin stressed in (static) tension and also in torsion (dynamic) and for Elektron Metal in torsion (dynamic) and for both duralumin and Elektron Metal in torsion (dynamic) after a preliminary bending fatigue. The Elektron metal shows a damping capacity (internal friction) greater than duralumin. RFM+EF(6)

Porter's Method for the Calculation of the Natural Vibration Frequency of Crank Shafts. (Verfahren von Porter zur Bestimmung der Eigenschwinungszahlen von Kurbelwellen.) K. Schlaefke. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 28, 1931, pages 404–405.

In order to reduce the usually rather tedious process of determining the torsional vibrations of crankshafts, Porter separates the shaft into few individual masses which are connected by massless pieces of the shaft or by pieces of uniform mass. The greater simplicity of this method as compared with the method of Wydler is illustrated by an example. Ha(6)

Methods of Testing. Proposed Definitions of Terms Relating to. F. B. Seely, Chairman, A. S. T. M. Sub-Committee on Elastic Strength of Materials. Appendix III to *Preprint* No. 4, Report of A. S. T. M. Committee E-1 on Methods of Testing, for June 1931 Meeting, *American Society for Testing Materials*, 3 pages.

Since a true elastic limit test, by the method of loading and releasing stress is seldom made, and the observed "proportional limit" depends on the sensitivity of the extensometer used, a new definition is proposed to bring out a method that will be universally applicable to the measurement of the property involved. The term "yield point" is to be abandoned for general use, since it applies only to materials that do have a sudden yield, like structural steel. Instead, the term "yield strength" is to be used, and the percentage of permanent set obtained at that load recorded. The terminology is to be, for example, yield strength (set = 0.1%) = 52,000 lbs./in.² Whatever value of set is adopted, it is to be stated. The yield strength may be obtained by plotting a stress strain diagram and drawing a line parallel to the elastic line, offset by the amount of set. The intersection of this line with the stress-strain curve shows the yield stress. If the nature of the material is known by prior tests, extensometers or dividers may be used for rough work. Umpire tests require the diagram. The elastic limit and proportional limit are limiting values of yield strength in which the set is not measurable, and hence, is considered to be zero. HWG(6)

Fourth Report of the Wire Ropes Research Committee. W. A. Scoble *Proceedings Institution of Mechanical Engineers*, No. 2, Mar. 1930, pages 553–602.

Large ropes are less efficient than small ones when tested under corresponding conditions. Compares 6-strand rope with 19, 24 and 37 wires per strand. On the largest pulley, of diameter 56.5 times that of the rope, there was little difference in performance. On smaller pulleys, the 6 × 24 was only slightly better than the 6 × 19, but the 6 × 37 showed a distinct superiority. More rapid bending of the rope does not reduce the endurance when the inertia effect of the pulley is eliminated. An increase in the length of rope bent, at least up to about 8 times the length of the lay is accompanied by a reduction of the number of bends which cause failure. Bending a rope through any angle over a pulley produces the same destructive effect until the angle of lap is reduced to 20° below which the endurance increases very rapidly. Accelerated elongation gives a warning of the approach of rope failure, but the indication is not always distinct with 6 × 37 ropes. Judged from the aspect of fatigue, all ropes show better performance on small pulleys than that indicated by the properties of the wire. On larger pulleys, the bending stress is reduced but the tension carried does not increase as rapidly as would be expected from consideration of fatigue alone. Present tests of wire are incomplete and unsatisfactory. Includes appendix and discussion. Results of tests made in Germany on the bending of wire ropes are given in the appendix. An account of these experiments appeared in *Zeitschrift Verein deutscher Ingenieure*, Mar. 20, 1929. RHP(6)

Speed of Tension Testing of Metallic Materials, Proposed Requirements for. J. H. Smith, Chairman, A. S. T. M. Sub-Committee on Effect of Speed of Testing. Appendix II to *Preprint* No. 4, Report of A. S. T. M. Committee E-1 on Methods of Testing, for June 1931 Meeting, *American Society for Testing Materials*. 3 pages.

Rate of application of stress in tensile tests up to the yield strength should be:

Structural Steel	24000 ± 5000 lbs./in.²
Monel Metal	2000 ± 5000 lbs./in.²
Brass and Copper	12000 ± 3000 lbs./in.²
Aluminum and Its Alloys	8000 ± 2000 lbs./in.²

Methods for determining the rate of increase of stress are described. HWG(6)

Recent Machines for Testing Vibrations. (Neure Schwingungsprüfmaschinen.) W. Späth. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Jan. 17, 1931, pages 83–85.

Vibration measuring apparatus exerts on the body, to be tested for vibrations, artificial periodic forces for which the point of attack, direction of attack, magnitude and frequency can be selected at will. The actions of these forces are recorded in resonance curves from which important characteristics, i. e., natural frequency, logarithmic decrement of damping, magnification factor, swinging mass, dynamic spring constant, etc., can be determined numerically. A few of such machines for the investigation of bridges, soil and other purposes are briefly described. 9 references are cited. Ha(6)

Good Selectivity Is Required for Magnetic Analysis. Sigfrid Spech (Ferrous Magnetic Corp.). *Steel*, Vol. 87, Dec. 18, 1930, pages 48, 50.

In magnetic analysis as usually conducted, much confusion arises from intermingling of the phenomena connected with the peculiarities of the apparatus for testing and those characteristic of the test specimen. Among the first can be mentioned the lack of coincidence between the theoretical and actually found-in-practice plane of the maximum magnetic flux, asymmetry in the angular relations between the axis of the coil and the lines of force, and non-symmetrical distribution of the magnetic characteristics on both sides of the center of the coil. By the use of several symmetrical induction systems strictly identical in their constants a considerable selectivity can be achieved in the separation among different observations permitting the identification in test specimens of grain size, the presence of segregations, non-metallic inclusions, cracks, seams, flows and other defects, as distinguished from stresses and strains. A hypothesis of the mechanism of testing is advanced. JDG(6)

The Determination of the Elastic Constants. (Die Bestimmung der elastischen Konstanten.) G. Berndt. *Zeitschrift für Instrumentenkunde*, Vol. 50, Nov. 1930, pages 624–638; Dec. 1930, pages 679–692.

The points covered are: (1) The Hertz definition; (2) Examination of the Martens mirror equipment; (3) Determination of the elongation λ', dilatation ϵ' and modulus of elasticity E with telescope and scale; (4) Determination of λ' and ϵ' with auto-collimation-telescope; (5) The immediate determination of the ratio of transformation; (6) Determination of the reduction of area with the instrument according to Sieglerschmidt; (7) Modified instrument applied; (8) Measurements on 9 steels (plain C, low Ni and Ni-Cr-steels and 18/8 Cr-Ni-steel); (9) Literature. EF(6)

Contribution to the Behavior of Materials Submitted to Dynamic Stress. (Beiträge zum Verhalten von Werkstoffen bei dynamischer Beanspruchung.) A. Esau & E. Voigt. *Zeitschrift für technische Physik*, Vol. 11, Mar. 1930, pages 78–81.

Refers to investigations on damping properties and on modulus of elasticity in dependence on temperature. EF(6)

Testing of Hardened Material and Enameled Pieces for Uniformity of Their Hardness and Quality of Surface Respectively by Cloud-Burst Test. (Prüfung gehärteter Werkstücke und emaillierter Gegenstände auf Gleichmässigkeit ihrer Härte bez. ihrer Oberflächenbeschaffenheit nach dem "Kugelregen"—Verfahren.) E. Franke. *Oberflachentechnik*, Vol. 7, Aug. 19, 1930, pages 151–153.

Not only the degree of hardness but also the uniformity of hardness is of great importance. The usual test methods of Brinell, Rockwell, scleroscope and the scratch method of Martens do not give a perfect indication as to the uniformity. A method by Herbert called cloud-burst test, permits testing the whole surface of the piece simultaneously. A great number of steel balls of 3 mm. diameter are dropped from a certain height onto the piece to be tested. With properly adjusted height dependent on the prescribed degree of hardness of the test material the test pieces remain perfectly undamaged while those of unsatisfactory hardness or showing soft spots are more or less roughened by the rain of little balls. The roughened places can be clearly recognized on the smooth background. The test lasts 1 to 2 minutes. The same test is very well suited also for enameled pieces; the height from which the balls are dropped is most appropriately about 1 to 1.5 m. without injury to the enamel. Several illustrations and a list of 5 references are given. Ha(6)

Magnetic Properties. Report of A. S. T. M. Committee A-6. T. Spooner, Chairman. *Preprint* No. 13 for June 1931 Meeting, *American Society for Testing Materials*, 8 pages.

The Committee is strongly opposed to the adoption of the series of magnetic units proposed by the U. S. Sub-Committee of the International Electro-technical Commission on February 16, 1931, in view of the confusion and complexity that would ensue, but favors its suggestion of the term "oersted" instead of "rowland" for the unit of magnetic force. A proposed method of alternating current test at low induction is appended. HWG(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

Brittle Fracture in Metals. B. H. HAIGH. *Engineering*, Vol. 130, Nov. 28, 1930, pages 685–686; Dec. 5, 1930, pages 717–719; Dec. 12, 1930, pages 752–753.

From lectures delivered at King's College, Nov. 1930, under the auspices of the Armourers and Braziers Company of the City of London. Reviews various types of brittle fractures. Different types are discussed and illustrated by photographs. Brittle fractures are due to triple tension, manner in which material is loaded or to fatigue. When a metal is exposed to tension in three mutually perpendicular directions, failure occurs without warning. Reviews various tests best fitted to develop triple tension including the Erichsen test, notched-bar test, Docherty's variation of the notched-bar test, and a test of Dr. Schurinning for determining the effect of speed in notched-bar tests. Final lecture is discussion of brittle fractures due to fatigue. Reviews early methods of fatigue testing. Recent tests show that heating has little to do with development of fatigue but if temperature of bar steadily increases, ultimate failure results. Curve is given showing results of tests made to determine effect of chemical action on fatigue of brass. Other curves show results obtained with Cu-Ni alloys. LFM(6f)

High-Frequency Fatigue Tests of Light Alloy Sheet Material. Sub-Committee on Metals. 16th Annual Report, *National Advisory Committee for Aeronautics*, 1930, pages 37, 38.

Preliminary data are given on results with the novel air-driven high-frequency apparatus at the Bureau of Standards for endurance limits of light alloys. The specimens are tested in vibration at frequencies of 215 to 310 cycles/second. The number of cycles to which the tests were carried is not stated.

Symbol	Material	Endurance Limit lbs./in.²
MAH	Mg alloy with 4% Cu, 0.4% Mn, as rolled, longitudinal and transverse	5000–6000
2SH	Commercial Al, cold-rolled, longitudinal and transverse	10000
3SH	Al alloy with 1¼% Mn, cold-rolled, longitudinal and transverse	12000
17ST	Duralumin 4% Cu, ½% Mg, ½% Mn, quenched and aged, longitudinal	15000
25SW	Al alloy, 4½% Cu, 0.8% Mn, 0.8% Si, quenched and aged, longitudinal	11000
51SW	Al alloy, 1% Si, 0.6% Mg, quenched and aged, longitudinal	10500
51ST	Al alloy, 1% Si, 0.6% Mg, quenched and aged, longitudinal	13000

In the symbols H = hard rolled, W = aged at room temperature, T = maximum heat-treated temper. The typical tensile strengths are about as follows, in lbs./in.²

MAH	43000
2SH	24000
3SH	29000
17ST	58000
51SW	35000
51ST	48000

HWG(6f)

Endurance of Sand-Cast Light-Metal Alloys. (Die Dauerfestigkeit der Leichtmetall-Sandguss-Legierungen.) W. SARAN. Published by Pfeffer & Balzer, Darmstadt. 1931, 87 pages, 56 figures, 17 references.

Endurance limits of various sand cast light alloys were determined within what the author thinks to be ± 5% of the true value, in the usual rotary bending test, in repeated torsion, and in a tension-compression or axial loading test. For the last a Schenck machine operating at 30,000 cycles per min. was used. The rotary bending and the torsion tests were at 3000 cycles per min. Tests were carried to 30–50 million on rotary bending, but only to 20 million on the tensile-compression tests and only to about 15 million on torsion. The S-N curves are not plotted logarithmically and the reader will have to replot in order to form his own judgment as to whether a true endurance limit was approached. The discrepancy between the rotary and the tension-compression tests is not satisfactorily explained as, beside the type of test, the cycle frequency and the number of cycles to which the test was carried, were also different. Saran is apparently not very sure of the accuracy of his tension-compression results, stating that they depend on the assumption that the modulus of elasticity has been correctly determined by static test for use in calculating the dynamic test. Rise-of-temperature observations, after the Lehr method, were made, but gave results wholly at variance with the endurance data. Test bars were turned from 0.7″ or 0.8″ diameter castings. All were made in dry sand except K. S. See Wasser, alufont and elektron which were cast in green sand. The alufont was quenched from 490° in water and aged at room temperature. Beside the data given below, static bend and torsion tests and studies of the hysteresis loops on repeated torsion were made. All the endurance data agree in showing low endurance values for the heat-treated alufont, not withstanding its higher tensile strength, that the Mg alloy was superior to the Al alloys in endurance, and that, of the Al alloys, the 6% Cu alloy has the best endurance properties except for silumin in torsion. Saran concludes that none of the "accelerated" tests, rise of temperature, change in rate of deflection or change in power consumption, are of any value in endurance testing of these alloys.

The Static and Fatigue Properties of Brass. J. B. KOMMERS. *Preprint* No. 48 for June 1931 Meeting, *American Society for Testing Materials*. 14 pages, 1 figure, 5 tables, 2 references.

Tensile, compression, Rockwell hardness and rotary beam fatigue tests were made on 80–20, 70–30 and 60–40 brass. The first and last contained 0.09% and the other 0.02% Pb. All contained 0.02–0.03% Fe, and the last 0.01% Sn. They were tested in cold-drawn condition, annealed at 527° and 1100° or 1300° F. and after compressing 20% after the high temperature anneal. Endurance limits (number of cycles to which tests were carried not stated) ran from 21,000 to 30,000 lbs./in.² The best values were at the 527° F. draw, though on 80–20, the 1100° F. anneal was as good. 60–40 had the highest endurance limit. Though the tensile strengths are higher in the cold-drawn condition, and cold work increases the endurance limits, the increase is not proportional and the brasses can be over-drawn so that the endurance drops. Cold work followed by the 527° F. anneal gives best endurance. Endurance is not proportional to any static property in these materials and cannot be predicted. HWG(6f)

Fatigue Stresses with Special Reference to the Breakage of Rolls. FREDERIC BACON. *Proceedings South Wales Institute of Engineers*, Vol. 47, Apr. 10, 1931, pages 141–335.

The behavior of rolls is greatly affected by fatigue. The hair crack markings on the freshly fractured faces of a broken roll are fatigue fractures. The alternating fatigue limit of the gray Fe core of a good roll is about 5 tons/in.² just below the mottle. The limits of the mottle are possibly lower due to the composite structure. In a new roll, the outer surface of the chill carries the greatest stress. The fatigue limit of chilled or white cast Fe is about 8 tons/in.² A week's work is roughly equivalent to 20,000 stress cycles. The superposition of a constant torque (T) will make no difference on the fatigue life of a roll subjected to alternating bending moment (M) provided T/M (ultimate tensile strength/alternating fatigue limit) is less than 2. T/M for the leading bottom roll of a train of 4 mills is less than 1.3, therefore there should be no difference between bottom and top rolls. The major principal stress in the leading bottom roll of a train of 4 mills is 30% higher than in a top roll, therefore bottom rolls should fail first if this were the criterion of failure. Hair cracks may form and not spread unless a certain critical depth (about the thickness of chill on a new roll) is exceeded. A mathematical investigation of stress ratios in revolving beams of lenticular section when compared with the hair crack markings actually found on the fractured faces of broken rolls and shafts shows that hair cracks tend to terminate in elliptic curves of uniform crest stress ratio. Curves have been constructed enabling the stress ratios to be evaluated from the hair crack markings on broken rolls. The imperfect elasticity of cast Fe is not sufficiently pronounced at stresses up to ½ its tenacity to seriously invalidate the ordinary equations of elastic bending, permitting the use of such equations for calculating fatigue stresses. At stresses above ½ the tenacity, strain increases much more rapidly than stress and the stress-strain curve in tension bends over much more than the stress-strain curve in compression. Hence the neutral axis drifts to the compression side. Thus, the distribution of stress assumed in the ordinary formulae for elastic bending is widely departed from. The error is large, differs according to whether the section is round or rectangular and will vary with sponginess of the Fe and intensity of stresses. The modulus of rupture for round test bars varies between 1.8 and 2.0 according to the equation $M_r = 1.1\ u + 9.5$ tons/in.² For cast irons of medium strength (the modulus of rupture on square bars/the modulus of rupture on round bars) = 0.89. For a given gray cast Fe the strength falls off with increase of section provided the smallest section shows no sign of chill. A 30-in. roll may be 3 times stronger but break under ½ the deflection of a 20-in. roll. An extensive bibliography is appended. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 80. AHE(6f)

Requirements of the Repeated Impact Test. (Zur Frage der Beanspruchung Beim Dauerschlagversuch.) S. BERG. *Forschungsarbeiten auf dem Gebiete des Ingenieurwesens, Verein deutscher Ingenieure*, No. 331, 1930, 28 pages, 53 figures, 15 tables, 82 references.

Mathematical and experimental study of the actual stresses, and the distribution of stresses in notched bars for repeated impact testing, with different types and depths of notches. The notch factor is also studied by a model consisting of a pile of rubber sheets into which projections are pressed, corresponding to the shape of the notch. The deformation of the layers of rubber is thought to give some indication of the stress distribution in a bar with that shape of notch. An interesting table shows, for a 0.14% C steel, cold worked to 0, 5, 9, 13 and 17% reduction, unannealed and annealed at 140°, 210°, 280°, 350° and 420° C., the number of blows to fracture on the repeated impact test, and the area of the final fracture, left after the advancing cracks from each side had progressed up to final fracture, and compares these figures with the notch toughness calculated from that final area and the work required to break it, and with notch toughness determined by single blow impact in the usual manner. Strengthening against repeated impact (number of blows required) increases, in unannealed material, as cold working increases but then decreases on the annealed specimens as the annealing temperature rises to 350° C. on the specimens reduced 5% and 9%, and to 280° C. on those reduced 13% and 17%. It then rises at the higher temperatures. The single blow impact test shows the final rise in all but the specimens with 9% reduction, but the dip in the curve is less marked than on the repeated impact test. HWG(6f)

Fatigue Strength of Carbon- and Alloy-Steel Plates as Used for Laminated Springs. R. G. C. BATSON & J. BRADLEY. *Engineering*, Vol. 131, Mar. 20, 1931, pages 405–406.

Condensed from paper read before the Institution of Mechanical Engineers, Feb. 20, 1931. Conditions of surface layer of spring steel plates cause fatigue resistance of complete laminated springs to be lower than mechanical properties of material would indicate. Fractures of laminated springs may be due to very low limiting ranges of stress obtained from unmachined plates compared with those from machined specimens. Deleterious layer could be removed by machining 1/16 in. from the surface. "Surface effect" was found to be produced by hardening and tempering. Only very slight improvement was obtained by heat treating spring plates after a thin layer had been machined from the surface of the rolled material. Tables are given summarizing results of tests made. LFM(6f)

	Composition											Endurance, lbs./in.²			
	Zn	Cu	Fe	Si	Mn	Mg	Sb	Al	Brinell[1]	Elongation %	Tensile lbs./in.²	Repeated bend[2]	Tension Compression[3]	Torsion[4]	Repeated Impact No. Blows[6]
German alloy	11.84	2.00	0.71	0.26	..	..	..	Bal.	65	<1	23,500	6,400	6900	3500	47,500
"American" alloy	0.28	5.78	0.75	0.47	..	0.08	..	Bal.	69	1.2	17,000	8,500	9900	4000	2,400
Piston alloy	...	14.40	0.58	0.23	..	..	..	Bal.	81	0	7,500	6,400	7250	3500	....
Silumin (unmodified)	...	...	0.48	11.79	..	..	..	Bal.	63	1.5	21,500	6,400	7000	5100	12,300
K. S. Seewasser	...	...	0.51	0.56	3.60	0.44	0.10	Bal.	60	<1	14,500	6,400	6900	3500	12,000
Lautal	0.09	4.70	0.51	2.47	0.02	0.01	..	Bal.	75	1.2	17,500	7,800	8500	3500	9,700
Alufont heat-treated	11.86	2.23	1.52	0.21	..	0.23	..	Bal.	114	0	36,000	7,800	6700	2500	....[5]
Elektron	2.40	0.08	tr.	0.19	..	Bal.	..	5.30	62	3	21,500	10,000	8500[5]	5400	166,000

[1] 10 mm. ball—1000 kg.—on 0.8″ diam. bar.
[2] To about 30–50 million cycles.
[3] To about 20 million cycles.
[4] To about 15 million cycles.
[5] Accuracy doubtful.
[6] Standard notched bar, 2 kg. hammer, falling 10 mm. calculated on cross section, blow = 1.51 cm. kg./cm.² No. blows is average of 10 tests.
[4] Ranges from 1300 to 10,000.
[4] Ranges from 6500 to 20,000.

HWG(6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Production of Electrolytic Iron Printing Plates. C. T. THOMAS & W. BLUM. *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 597–598.

From paper presented before American Electrochemical Society, May 29–31, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 796. MS(7a)

Purification and Analysis of Alkali Cyanides. M. R. THOMPSON. *Bureau of Standards Journal of Research*, Vol. 6, June 1931, pages 1051–1059.

Alkali cyanide is an essential constituent of solutions used to electroplate with certain metals, including gold, silver, copper, cadmium, zinc and their alloys. This paper summarizes the results of other investigators on the laboratory preparation of alkali cyanides of high purity, and considers several volumetric methods which have been used for the analysis of the product. Particular attention is given to the titrations with mercuric chloride (Hannay), nickel sulphate (Lundell) and silver nitrate (Liebig-Deniges). In the present work, potassium and sodium cyanides were synthesized from liquid hydrocyanide acid and the appropriate hydrogen or ethoxide in ethyl alcohol solution. No difficulty was found in thus producing potassium cyanide of high purity, but the sodium cyanide was always less pure. This difference was traced to the reactions and solubility relations for potassium and sodium salts in ethyl alcohol. Methyl alcohol was found to be suitable for recrystallizing cyanides in certain cases, as the alkali salts are more soluble in it. When applied to the potassium cyanide, the silver nitrate (Liebig-Deniges) method of analysis was found to be the most accurate. WAT(7a)

Commercial Control of Silver Plating. A. E. THURBER. *Monthly Review American Electroplaters' Society*, Vol. 18, Jan. 1931, pages 4–17.

Paper with discussion. A general discussion of the control of plating as it is affected by the properties of the base metal, by the finishing operations of forming, grinding, buffing and polishing. A method is described for testing the paper used in packing for sulphur content since even as low as 0.0004% is liable to form silver sulphide tarnish. The factors for insuring uniformity and high efficiency are discussed and the influence of racking or wiring arrangement is pointed out. In the discussion, some practical points are brought in comparison with European practice. Ha(7a)

Plating on Radiator Shells. OLIVER P. WATTS. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, page 1060.

Abstract of paper read before the American Electrochemical Society See abstract in *Metals & Alloys*, Vol. 1, Dec. 1930, page 912. MS(7a)

The Deposition of Bright Zinc-Cadmium Alloys from Cyanide Baths. C. J. WERNLUND. *Monthly Review American Electroplaters' Society*, Vol. 17, Dec. 1930, pages 4–9.

The brightest and most pleasing deposits are obtained with anodes containing from 8 to 15% cadmium. A preferred bath concentration is:

$Zn(Cu)_2$	75.0 g./l.	or	10 oz./gal.
NaCN	37.5 g./l.	or	5 oz./gal.
NaOH	90.0 g./l.	or	12 oz./gal.
CdO	3.0 g./l.	or	0.27 oz./gal.

under the following operating conditions:

Anodes	8 to 15% Cd, balance Zn
Anode current density	6 to 10 amp./ft.^{2}
Cathode current density	13 to 60 amp./ft.^{2} (20 to 40 preferred)
E. M. F.	1 to 3 as required
Cathode current efficiency	90 to 100% (based on Zn)

The deposit is a successful rustproof coating and has a very great resistance to corrosion. It can also be deposited on malleable and cast iron and adheres well to steel. Ha(7a)

Silvery Platings. H. WHITEHEAD. *Product Engineering*, Vol. 2, Apr. 1931, page 171.

An entirely silver-like finish on smaller articles such as jewelry, household appliances, etc., can now be obtained by plating with palladium or rhodium, or with a co-deposition of nickel and cobalt, or by platinum. The metals of the platinum group are particularly resistant to tarnishing since their melting point is high. Ha(7a)

Some Theoretical and Practical Aspects of Cadmium and Zinc Plating. S. WERNICK. *Preprint, Electroplaters' and Depositors' Technical Society*, London, Apr. 15, 1931, pages 129–152; *Metal Industry*, London, Vol. 38, May 22, 1931, pages 531–533; June 5, 1931, pages 579–581.

The intrinsic protection against corrosion of iron and steel is greater in the case of zinc coating as compared with cadmium coating. But the rate of sacrificial corrosion of the coating is much less in the case of cadmium, making the latter more durable. Cadmium and iron are so close in the electromotive series that under certain conditions the protection provided is negligible. The color of zinc deposit from sulphate bath is superior to that from cyanide bath. The color of cadmium deposit is whiter. Due to the ductility of cadmium deposit it retains protective value when subjected to mechanical treatment. But cadmium is softer than zinc, and therefore has less resistance against abrasive wear. Due to its ready oxidation, cadmium is not suited as a base for japan and enamel finishes. The reaction of cadmium to 14 common chemicals is considerably less than that of zinc. Corrosion tests conducted in sodium chloride and ammonium chloride media indicate that there exists a minimum thickness of cadmium deposit which will provide satisfactory protection. A point of inflection is found on the curve connecting thickness of deposit with durability which suggest a minimum thickness of 0.0002" for rust prevention, and 50% more is recommended for practical applications. Aside from thickness, the cadmium deposit must be fine grained which is obtained only by accurate control of bath composition and plating conditions. Following are recommended for the bath: Cadmium content 3%, free cyanide 100% over the combined cyanide, alkali content 1.5 to 3%, current density not over 15 amp./ft.^{2}, temperature not over 30° C. PRK+LCP(7a)

Production Nickel Plating at Low pH. C. E. CLINDININ. *Monthly Review, American Electroplaters' Society*, Vol. 18, Mar. 1931, pages 11–24.

The author gives the results of his experience with the General Spring & Bumper Corporation. Among the advantages of plating at a low pH: (1) price saving because nickel as anode is cheaper than nickel sulphate; (2) easier to obtain anodes of a given high purity than is the case with nickel salts; (3) cost of handling is lower. Discussion brought out a great number of practical questions. MFB(7a)

A Silver-White Alloy Plate. COLIN G. FINK & KIHOUGH H. LAH. *Monthly Review American Electroplaters' Society*, Vol. 18, Jan. 1931, pages 29–34.

A silver-white cobalt-nickel alloy can be deposited by the proper selection and arrangement of the nickel and cobalt anodes. The cathode was of brass. The experimental work is described. The whitest plates were 55 to 75% Ni and 45 to 25% Co. The hardness test gave 250 Bierbaum units for alloys from 100 to 25% Co. The corrosion was found to be least for about 50% cobalt, with a loss of 0.51 mg./in.^{2} See also "The Deposition of Nickel-Cobalt Alloys," *Metals & Alloys*, Vol. 1, Dec. 1930, page 910. Ha(7a)

The Economical Heating of Plating Vats by Gas. *Metal Industry*, London, Vol. 38, May 22, 1931, pages 525–526.

For economical heating of vats, improved burners of large heating capacity should be used and vats should be placed in brick settings. PRK(7a)

Electrolysis. (Elektrolyse.) P. GERHARDT. *Oberflächentechnik*, Vol. 7, Sept. 2, 1930, pages 161–162; Sept. 16, 1930, pages 171–173; Oct. 7, 1930, pages 181–182; Oct. 21, 1930, pages 191–192.

The purpose of electrolysis is to disintegrate, by means of an electric current, an electrically conductive solution such as the watery solution of an acid, a base, or a salt, or a molten liquid; to dissociate them by discharge of its positive and negative components. The conductivity depends on the mutual mobility of the molecules and the disintegration products of the latter as well as on the temperature. The behavior and dissociation phenomena are explained in general and illustrated by a few more or less complex electrolytes. The electrical units for electrolysis are explained; it is shown how current and dissociation voltage can be calculated. A table of dissociation voltages for a number of electrolytes is given. Nernst's law for the e.m.f. required for a metal to pass an ion from its surface into the solution is explained; the anodic phenomena and normal potentials are discussed; and the influence of temperature explained. The more recent reviews on the nature of electrolysis seem to replace the older dissociation theory of Ostwald (because of its failure for strong electrolytes) by a new equilibrium theory. This equilibrium must exist in the system between the ions on one side, on the other between the ions and the agglomeration formed by them. This view was corroborated, to a certain extent, by the recently acquired knowledge of the nature of ions. The solution molecules are under the influence of exterior electric fields and interact with the ions according to their mutual charge and their distance. Ha(7)

Chromium Plating of Tools and Gages. LT. WILLINK. *Monthly Review American Electroplaters' Society*, Vol. 18, Apr. 1931, pages 32–44.

Some practical information on chromium plating at the Frankford Arsenal. Chrome plating of tools and gages has resulted in great savings. Ha(7)

Chromium Plating, Its Application in the Ceramic Industry. HARRY C. WOLFE. *Ceramic Age*, Vol. 16, Dec. 1930, pages 315–317, 322–323.

The author distinguishes between lustrous plating of a thickness of 0.000005 to 0.00001 in. and hard plating for wear and resistance to abrasion of 0.003 to 0.005 in. In the ceramic industry, hard plating of mixers, glass collecting rods, pump plungers, dies, etc., increases their life many times. Ha(7a)

How to Plate Aluminum Die Castings. HAROLD K. WORK (Aluminum Co. of America Laboratories). *Metal Progress*, Vol. 19, Apr. 1931, pages 68–70.

The author describes methods of plating aluminum base die castings with various metals and their applications. WLC(7a)

High-Output Nickel Baths and Conversion of Old Nickel Baths to Higher Output. (Hochleistungs-Nickelbäder und Umstellung alter Nickelbäder auf höhere Leistung). *Oberflächentechnik*, Vol. 7, Dec. 2, 1930, pages 223–225.

For very high current densities (10 amp./dm.^{2} and more) the bath must operate under increased metal contents and temperature and, besides, moving of the cathode and stirring of the electrolyte becomes necessary. Means for obtaining this end are described. The working temperature should be 60° C. The proper ratio between concentration, temperature and density is of great importance. For fast deposits, the danger of formation of pores exists and this prevents the formation of the homogeneous covering necessary for protection against corrosion. The changes to be made in the old baths to obtain higher outputs are discussed. Proper concentration is given for high outputs, 35–40 kg. nickel salt for each 100 l. Ha(7a)

Galvanic Metal Deposition with Superposition of Alternating Current. (Galvanische Metallabscheidung mit Wechselstromüberlagerung.) GALVANICUS. *Oberflächentechnik*, Vol. 7, Nov. 4, 1930, pages 201–214.

Certain experiments have been made recently to determine the effect of an alternating current on the deposition of metal when it is superimposed on a direct current. It can be stated that such superposition has a depolarizing effect. The alternating current reduces the anodic and cathodic polarization and the electro-chemical passivity. This action is illustrated by the example of nickel-plating. The superposition of alternating current resulted, here, in a much more uniform deposit with a less changeable structure. The mechanical properties were better than when deposits were made by direct current. Microscopic examination revealed certain differences between deposits in chloride and sulphate electrolytes; these are discussed at length. The reduction of the cathode polarization in chloride solutions for a ratio of d. c. to a. c. of:

1: 2 amounts to about 0.10 volt
1: 4 amounts to about 0.18 volt
1:10 amounts to about 0.22 volt

For sulphate solutions, the effect is about the same. This method also makes the use of pure nickel anodes possible while with d. c., impure anodes are necessary because pure nickel is not dissolved fast enough. The superimposed a. c. improves the dissolution so that pure metal can be used. This method may become especially useful for alloy deposits. Tests with nickel-zinc alloys showed a greatly increased nickel content in the deposited material with increasing ratio of a. c. to d. c. The respective test curve is reproduced. This method has found a wider industrial use in the electric refining of gold where the a. c. has to improve the solution at the anode. In conclusion, it is said that this process gives good promise for industrial application, although at present the laboratory stage is not fully overcome. Ha(7a)

Acetamide and Formamide as Solvents for the Electrodeposition of Metals. L. F. YNTEMA & L. F. AUDRIETH. *Journal American Chemical Society*, July 1930, pages 2693–2698.

Zinc, cadmium, lead, tin, cobalt and nickel were deposited electrolytically from solutions of their salts in formamide. Current densities were of the order of 0.02 to 0.04 amp. /cm.^{2} and temperature 100° C. The same metals and also thallium were deposited from acetamide solutions under similar conditions. Metals higher than zinc in the e. m. f. series were not deposited from solutions in either solvent. MEH(7a)

The Use of Brighteners in Plating Solutions. JOE HOEFER. *Monthly Review, American Electroplaters' Society*, Vol. 18, June 1931, pages 23–29.

Includes discussion. Paper before Chicago branch of American Electroplaters Society, Annual Meeting, January 1931. Most brighteners used in plating baths are colloids which act as an elastic membrane around metal ions in the baths. This membrane prevents deposition of large groupings of metal ions with the result that the crystals in the cathode deposit are small. This membrane also causes cathode polarization, although polarization itself has no direct bearing on crystal formation at the cathode. Experimental data are given to show that small amounts of glue and cadmium chloride increase the voltage of sulphate copper bath and nickel bath, respectively.

Bath	Brightener	Concentration mg./l.	Bath Voltage	Cathode Current Density amp./ft.^{2}	Character of Deposit
Sulphate Copper	Glue	0.0	0.76	21	Large crystals
		0.1	0.82	21	Small crystals
		0.2	0.83	21	Small crystals
Cold Nickel	Cadmium Chloride	0.0	1.9	10	Fine crystalline
		0.1	2.0	10	Smooth, fine crystalline
		0.15	2.2	10	Smooth, fine crystalline
Hot Nickel	Cadmium Chloride	0.0	2.5	35	Crystalline
		0.15	2.8	35	Finer crystalline

LCP(7a)

The Treatment of Cyanide-Alkali Baths in Electroplating. (Ueber die Behandlung cyankalischer Baeder in der Galvanotechnik.) Laboratory of Langbein Phanhauser Works in Leipzig. *Oberflächentechnik*, Vol. 8, Jan. 20, 1931, page 13.

The above company is one of the leading electroplaters in Germany and has the following suggestions to offer in regard to handling cyanide-alkali baths. First of all, in preparation and regeneration of bath, the use of cheap double salts must be avoided because they contain large amounts of potassium or sodium. If they are used, the current efficiency is not only impaired but also the quality of copper coating, due to the excessive amount of hydrogen evolved at cathode. Whenever potassium or sodium carbonate happens to be present in large amounts, the new bath must be made up, or they can be readily removed in cold winter days by allowing the bath to cool 5° C. below zero. The deposited crystals of sodium carbonate can then be removed by iron shovels. Second, cast anodes must be used; whenever rolled anodes are used, they must, prior to service, be thoroughly annealed. Third, if there is an abundant development of anodic slime in the brass or copper bath, the excessive use of ammonium chloride must be avoided. ER(7a)

Plating Household Specialties. C. L. Etchison (Everedy Co., Inc.) *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, pages 693–696.

Deals with the procedure of the Everedy Co., Inc., Frederick, Md., in burnishing, tumbling, polishing, cleaning, and Ni, Cd, Cu and brass plating articles such as strainer sets, screen door grilles, bottle cappers, siphon fillers, etc. MS(7a)

Deposition of Nickel-Cobalt Alloys. C. G. Fink & K. H. Lah. *Metal Cleaning & Finishing*, Vol. 2, Oct. 1930, pages 867–868.

From paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 910. MS(7a)

Electrodeposition of Nickel and Chromium on Zinc Die Castings. Samuel Gordon. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 765–766.

Castings are polished to a very good, non-porous surface and are cleaned electrolytically by immersion in a good commercial cleaner for 15 sec. at 1500° F. They are rinsed in cold H_2O and flash plated in a brass solution containing 1 gal. H_2O, $4^1/_3$ oz. NaCN, 3 oz. $Cu(CN)_2$, 1 oz. $Zn(CN)_2$, 2 oz. Na_2CO_3, and 1 qt./100 gal. solution, NH_4OH. If Ni is to be deposited directly, the parts are cleaned, rinsed and dipped in 20% HF. After rising in H_2O, the articles are plated for 4–5 min. at 800° F. in a bath consisting of 1 gal. H_2O, 6 oz. $NiSO_4$, 2 oz. $NiSO_4.(NH_4)_2SO_4$, 4 oz. NaCl, 2 oz. $MgSO_4$, 2 oz. $Na_2SO_4.10H_2O$, and 1 oz. H_3BO_3. Solution should have pH of 6.8. Articles are then rinsed in cold and hot H_2O, dried in sawdust and color buffed. They are then Cr plated for 3–5 min. at 90° F. using a c. d. of 75 amp./ft.^{2}, in a bath containing 1 gal. H_2O, 48 oz. CrO_3, 1 oz. $Fe_2(CrO_4)_3$, and $^1/_2$ oz. C. P. Na_2SO_4. They are washed in cold and boiling H_2O, dried at 200° F. and color buffed. MS(7a)

Electroplating Automobile Bumpers in a Full Automatic Plating Machine. J. M. Mayers. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, page 722–724.

Describes a machine in which the bars are suspended horizontally. The anodes are bent to approximately the same curvature as the bumper, thus giving even current distribution. The bumpers are held in the rack inclined at about a 45° angle with the face of the bar toward the anodes. About half of the vertical parts of the anodes are above the bumpers. Only a 24 in. lift is necessary in the transfer mechanism. A tank only 36 in. deep is required. MS(7a)

Gold Solutions. O. Sizelove. *Monthly Review American Electroplaters' Society*, Vol. 18, Apr. 1931, pages 45–50.

Three methods of depositing gold are described and the compositions of the electrolytes given: the cyanide method, the salt water method and the immersion method. For obtaining green gold, largely an alloy of gold and silver, sometimes cadmium, a cyanide bath is operated at 95° to 100° F. White gold is obtained by adding nickel to the cyanide gold solution, and copper for 14 carat gold. Rose gold solutions are fine gold solutions with an addition of caustic soda or potassium carbonate. Ha(7a)

Chrome Plating in Patent Literature. (Die Verchromung in der Patentliteratur.) R. Justh & F. Markhoff. *Oberflächentechnik*, Vol. 8, June 2, 1931, pages 118–124.

A complete tabulation of patents dealing with chrome plating in America, Germany, Austria, Great Britain, France and Switzerland, without regard to the practical value of the patent. Patents since 1852 are included. They are arranged in the order of the date of their application and are subdivided thus: (1) electrolytes based on chrome acid; (2) chromium electrolytes based on low-valency compounds of chromium; (3) melt electrolysis; (4) deposition of chromium alloys; (5) anodes; (6) anodic pretreatment; (7) thermal treatment; (8) intermediary coatings; (9) miscellaneous methods; (10) covering of the baths; (11) miscellaneous devices; (12) chrome plating of quantity articles; (13) application of chrome plating. A commentary on the importance of some of the patents is added. Ha(7a)

Design for Electroplating. G. Soderberg. *Product Engineering*, Vol. 2, June 1931, pages 262–264.

Suitable design for articles which are to be plated in full automatic plating machines is of particular importance. Points which must be watched are depth of hollows, shape of inside corners and projecting parts, shielding of one part by another, elimination of gas pockets, proper draining, method of hanging on hooks or immersing and stability of suspension. Ha(7a)

Electrodeposition of Iron-Nickel Alloys from Cyanide Solutions. Lawrence E. Stout & Jonas Carol. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, page 946.

Abstract of paper read before the American Electrochemical Society See *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. MS(7a)

Introduction of Iron into Alkaline Cleaning and Plating Solutions. E. J. Liscomb. *Monthly Review American Electroplaters' Society*, Vol. 18, Jan. 1931, pages 17–29.

Paper with discussion. The reason for numerous failures of steel plating tanks has been investigated. The tank should never be made the anode of the circuit because eventually corrosion is sure to follow. Caustic soda, soda ash or sodium cyanide, when used as a cleanser, will cause no trouble as long as there is no salt such as sodium sulphate, trisodium phosphate, sodium chloride or ammonium chloride present. Work which is pickled in hydrochloric acid or any other acid should be well neutralized and rinsed several times in clean water before going to a plating solution. Cleaning and alkali plating solutions should be free from all chlorides or the tanks should be rubber lined. Another line of useful suggestions is added. Most of them are corroborated in the discussion. Ha(7a)

The Electrochemical Behavior and the Dissolution Speed of Single Crystals of Zinc in Sulphuric Acid. (Das elektrochemische Verhalten und die Auflösungsgeschwindigkeit von Zinkeinkristallen in Schwefelsäure.) M. Straumanis (University of Riga). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 147, Apr. 1930, pages 161–187.

Potential measurements in neutral and acid zinc sulphate solutions and dissolution speed of single crystals of Zn in acids. EF(7a)

Theory of Dissolution of Metals. (Zur Theorie der Metallauflösung. Zugleich Antwort an die Herren Thiel & Eckell.) M. Straumanis (University of Riga). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 148, June 1930, pages 349–380.

The theory of the difference effect is summarized and some conclusions are drawn therefrom. EF(7a)

Practical Use of the Electromotive Series in Electrodeposition and Separation of Metals. J. J. Mulligan. *Monthly Review American Electroplaters' Society*, Vol. 18, Apr. 1931, pages 5–8.

A discussion of faulty conditions during plating which may be due to electrolytic trouble, too high voltage, temperature, concentration or some other condition. Most of these can be controlled by proper consideration of the electro-chemical order elements. Ha(7a)

Electrometallurgy (7b)

Electrolytic Extraction of Tin and Copper from Bronze Scrap. (Extraction electrolytique de l'etain et du cuivre des dechets de bronze.) O. Scarpa. *Bulletin de la société Française des Electriciens*, Vol. 10, May 1930, pages 572–579.

Scrap bronze is melted in a reverberatory furnace and cast into anodes which are electrolyzed in sulphate solution for the recovery of Cu in the usual manner. The solution is continually purified from colloidal SnO_2 by passing it through heating tanks. The slimes containing all Sn in the form of oxides are converted into stannates which are chemically purified and converted by electrolysis into a very pure Sn sponge which is then melted. JDG(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Crystal Forms of Galvanizer's Dross and Zinc-Iron Alloys. Wallace G. Imhoff. *Iron Age*, Vol. 126, Dec. 18, 1930, pages 1853–1854; Dec. 25, 1930, pages 1932–1934.

Crystals are classified under 6 systems. Fe and Zn are found in isometric or cubic system and the hexagonal system. The temperature and amount of components present affect the crystal form of the alloy and its chemical composition. Zn heated to 900° F. for 6 hrs. and slowly cooled did not show any dross or Zn-Fe alloy. Pure Zn heated to 950° F. showed traces of both Zn-Fe alloys and dross. Dross crystals are characteristically long and slender. Alloy action of Zn begins at melting point of Zn. As temperature is raised, alloying action on Fe becomes stronger. Dross crystals pack tightly when heated. Dross consists of the melt and the Zn-Fe alloy crystals. As temperature increases, the Zn-Fe alloy appears to lose Zn. Crystal system changes completely at higher temperatures. Fe content increases with rising temperature. Results show that such alloys as $FeZn_3$, $FeZn_5$ and $FeZn_7$ are not present in ordinary galvanized coatings but are rather Zn-Fe alloys formed at higher temperatures. VSP(8)

Bendability of Galvanzied Coatings. (Biegefähigkeit von Zink-Ueberzügen.) Heinz Bablik. *Zeitschrift für Metallkunde*, Vol. 22, May 1930, pages 171–173.

See *Metals & Alloys*, Vol. 2, Jan. 1931, page 8. EF(8)

Sprayed Aluminum Coatings. Leopold Pessel. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, page 228.

When rolled aluminum sheet is exposed to salt water spray, the surface is pitted and in addition elongated, blister-like exfoliations appear in direction of rolling. Tests showed that spraying the sand-blasted surface with molten aluminum prevented such exfoliations. PRK(8)

Hot Galvanizing with Zinc and Cadmium. (Die Feuerverzinkung und Feuervercadmiung.) K. Sch. *Chemiker-Zeitung*, Vol. 55, Mar. 25, 1931, pages 225–226.

About half of the total production of Zn is used for galvanizing iron and steel. The parts should be pickled in 10–20% warm H_2SO_4 or cold HCl for $^1/_2$ to 2 hours to remove scale. The Zn is melted in an iron pot, evenly heated by gas, oil or coke. The temperature should be as low as possible to prevent alloying of Zn and Fe, which is objectionable. The Zn should be reasonably pure, with Pb not over 1.6% and Fe not over 0.08%. From $^1/_4$ to 3% Al is sometimes added to increase fluidity. The Zn is covered with a mixture of NH_4Cl and glycerin to protect it against oxidation. With the Zn at 430° to 490° C. the articles are immersed in it for several minutes, withdrawn, and the excess Zn shaken off. Galvanizing with Cd is done in the same way except at about 360° C. Fe does not interfere as it does not alloy with Cd. Cd coating is softer than Zn. Dipping in 17% Zn and 83% Cd at 300° or in 29% Cd and 71% Zn at 220° produces good results, especially for exposure to CO_2 and NaCl. CEM(8)

"Zinc Slinger" Aids Galvanizing. *Brass World*, Vol. 27, Apr. 1931, page 84.

A machine for removing excess zinc from metals which are galvanized by the hot immersion method is offered by N. Ransohoff, Inc., Cincinnati, O. It has aided in improving the appearance of the galvanized pole line hardware, while making for greater efficiency in production at the plant of Hubbard & Co., Pittsburgh, Pa. The first section is a slanting hooded perforated metal barrel, gas heated. The barrel revolves at 50 r. p. m. The excess zinc is removed and reclaimed in a chute beneath the hood. Parts travel into a larger drum, revolving slowly in water. This quenches, but does not cool, and the zinc is set. The finished parts are discharged and dry of their own heat, resulting, it is claimed, in a better finish, elimination of surplus zinc on threaded work, increased production and lower costs. WHB(8)

Effects of Various Gases in the Kiln on Burning of Bright Gold for Gilding Ceramic Wares. A. Nakatsuchi. *The Journal of the Society of Chemical Industry*, Japan, Vol. 34, Feb. 1931, pages 67B-69B.

Sulphur dioxide, hydrogen sulphide, hydrogen and carbon dioxide are injurious gases for burning of bright gold; the best atmosphere is nitrogen gas containing a little oxygen, but the process is not practicable. Moisture does not affect the decomposition of bright gold. MB(8)

Metal Coatings (Metallische Ueberzüge). E. Liebreich. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Apr. 25, 1931, pages 529–530.

Chemical, physical and mechanical resistivity of metal coatings are discussed in general and a brief description given of different methods of coating. Ha(8)

Galvanizing Pots, Their Material and Construction. F. Hausmann. *The Pure Iron Era*, Vol. 3, No. 11, 1930, pages 14–17.

Of all steels tested for loss of material in molten, pure iron, Armco Ingot Iron, showed the lowest loss figure. The pots are welded by water gas or oxy-acetylene. A thickness from 25 to 40 mm. according to the size of the container is desirable. Several large tanks are illustrated. Ha(8)

The Surface Treatment of Aluminium and Its Alloys. *Foundry Trade Journal*, Vol. 44, Apr. 30, 1931, pages 301–302; May 7, 1931, pages 329–331.

An article based on information published by the British Aluminium Company, Ltd., on methods available for treating the surface of aluminum with a view to its decoration or protection. Mechanical processes of surface treatment are dealt with, and chemical methods are very completely described. Methods of plating also receive some consideration. OWE(8)

On the Determination of the Thickness and the Quantities of Coatings on Galvanized Iron. (Ueber die Bestimmung der Dicke und der Eigenschaften der Schutzschichten auf galvanisiertem Eisen.) Vondracek. *Korrosion und Metallschutz*, Vol. 5, Sept. 1930, page 206.

Refers to a paper presented before the International Congress for Mining, Metallurgy and Applied Geology, 1930. EF(8)

INDUSTRIAL USES & APPLICATIONS (9)

Finishing Stainless Steels, Pickling, Polishing and Welding. C. C. SNYDER (Republic Steel Corp.). *Metal Progress*, Vol. 19, Feb. 1931, pages 77–80.

Classification of stainless materials is made, applications to exposed parts of motors cars and decorative purposes in buildings are discussed. The properties of one class, the 16–20% Cr and 7–10% Ni alloys, are given and discussed in detail. Welding and structural applications of this alloy are described. Pickling solutions and polishing methods are discussed. WLC(9)

Relation between Welded-on Overlays and Heat Treatment. MILES CATLIN SMITH (Stoody Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1160–1176.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The possibilities of economies in machine construction with proper combination of welded overlays as well as diminished wear in service are described and discussed. WLC(9)

Steel for Good Welding. W. E. STINE (Lincoln Electric Co.). *Power Plant Engineering*, Vol. 35, July 1, 1931, page 710.

Alleges that proper steel for welding should have a certain balance among Mn, Si and Al, in relation to carbon content. This is shown in curves. The allowable Al runs in a straight line from 0.001% at 0.1% C to 0.005% at 0.5% C. Manganese runs from 0.15% at 0.1% C to 0.66% at 0.30% C, thence to 1.2% at 0.40% C. Silicon runs from 0.01% at 0.10% C to 0.045% at 0.40% C, and thence to 0.07% at 0.55% C. HWG(9)

Ship Building and its Relation to the Steel Industry. H. G. SMITH (Bethlehem Shipbuilding Corp.). *Preprint* for May 1931 Meeting, *American Iron and Steel Institute*, 26 pages.

Traces growth of use of steel in ships. Mass production is seldom possible as each ship is specially designed. All forming and fabrication is best done at the shipyard. Total annual demand for iron and steel products in American shipbuilding and repair is about 36 million dollars. Needs of the industry are for workable steels of higher tensile strength, highest possible modulus of elasticity and lowest possible coefficient of thermal expansion. High steam pressures and the requirements of the Diesel engine both call for better materials to withstand high temperatures and high stresses. HWG(9)

Use of Aluminum in the Decorative Arts. (Verwendung von Aluminium im Kunstgewerbe.) CLEMENS SIMON. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 238–249.

A collection of photographs showing the extensive use of aluminum furniture especially in hospitals, accessories for windows, doors, etc. Ha(9)

Welded Cranes. (Geschweisste Krane.) H. SCHMITT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 23, 1931, pages 652–653.

Discussion of advantages of welding over riveting in cranes and of the best methods of joining parts and their testing. Some illustrations are included. Ha(9)

Aluminum in the Brewing Industry. (Aluminium in der Brauerei-Industrie.) SIEPKE. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Nov. 1930, pages 177–190.

Aluminum of a purity of 99.3% to 99.5% is fully resistant to the ingredients used in beer brewing; also, the taste is not changed so that storage tanks of aluminum are as good as wooden tanks. The fermentation process was not influenced by the greater heat conductivity of the metal as against wood. The disinfectants used to-day are described and their degree of eventual toxicity and their action on aluminum are discussed. Only activin and formaldehyde may be used for disinfection of aluminum apparatus. The latter part of the article deals with the equipment of breweries for which aluminum can be used; how tanks should be dimensioned; what advantages accrue from its use; how aluminum tanks should be transported; and how the ratio of price per 100 l. changes with the tank dimensions. Ha(9)

Autogenous Cutting of Springs. (Autogenous Schneiden von Federn.) O. SCHEH. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 28, 1931, page 392.

Springs have been made by cutting a helical opening in a pipe or solid steel block. Tests showed that, axially and tangentially, no difference in strength exists; a subsequent treatment is not necessary. This method is superior to that of winding a steel rod around a mandril, especially if the inner and the outer diameter are widely different. These autogenously cut springs were made by Siemens-Schuckertwerke and used for coupling machines. Ha(9)

Steels Used in Ford Industries. J. L. MCCLOUD. *Metal Progress*, Vol. 19, Mar. 1931, pages 32–39, 83.

Methods of classification, storage and differentiation between a large number of steels are described with a chart showing the markings given, properties and analysis. Heat treatment of various parts are discussed. Applications are discussed for Cr, Mn and CrNi steels. Fatigue applications of case carburized parts are described. WLC(9)

Metal Toys Look Real. JOHN MAPES. *Metal Progress*, Vol. 18, Dec. 1930, pages 33–39.

Describes methods of manufacture of various metal toys. Variety of metals, production methods and engineering design essential to production of a good line of metal toys are discussed. WLC(9)

Diverse Metals in Huge Terminal. J. W. LOVE. *Metal Progress*, Vol. 19, Jan. 1931, pages 33–38.

Description of the new Union Terminal Station in Cleveland and its many applications of metals. WLC(9)

Manganese Steel has Many Functions. W. A. LONGDEN. *Edgar Allen News*, Vol. 9, Apr. 1931, pages 845–849.

Illustrations of coal cutters, steel buckets, tractor links, gravel pump castings, etc., made of a special manganese steel by Edgar Allen & Co., Ltd., Sheffield, England. Ha(9)

The Relation of Steel to Agriculture. W. D. LAUFER. *The Steel Maker*, Vol. 2, No. 1, pages 45–47.

An enumeration of the very varied articles and implements used at present by farmers. The quantities of steel necessary to their production are considered. Ha(9)

Die and Roll Steels for Brass Mill. H. G. KESHIAN (Chase Companies). *Metal Progress*, Vol. 18, Nov. 1930, pages 75–80.

Uses of wrought iron, high chromium iron and cast iron for such applications as stirring molten metal, thermocouple protection tubes and ingot molds are described. Steels used in rolls, cold shears, drawbench chains and cold drawing dies are discussed. Hot working steels are discussed under the headings, general requirements, types of steels, hot piercing, hot forging and extrusion. Suggested compositions of steels are given for the various applications discussed. WLC(9)

High Pressure with Steel Castings. WM. H. JACOBI. *Product Engineering*, Vol. 2, June 1931, page 245.

Pump cylinders and similar parts are made by the Keokuk Steel Casting Co. of a carbon steel with 0.275 to 0.3% C; tensile strength of 75,000 lbs./in.^{2}; elastic limit, 41,000 lbs./in.^{2}; elongation 27%. Steels of a tensile strength of 200,000 lbs./in.^{2} are obtainable. Ha(9)

Old Ornamental Ironwork Embodies Traditions of Early Days. MARY WILLIS SHUEY. *Steel*, Vol. 87, Oct. 23, 1930, pages 47–49.

Description of some examples of early Spanish, French and American ornamental ironwork of cast-iron and wrought-iron in the Vieux Carre district of New Orleans. Suggests adaptation of corrosion-resistant steels for such decorative work. MS(9)

Neglected Bridge and Highway Guards Offer Opportunities for Steel Products. *Steel*, Vol. 87, Sept. 18, 1930, pages 23–25.

Discusses the necessity for making bridge and highway guards safe for modern traffic, and shows how steel products are suited for this purpose. MS(9)

Aluminum Alloys Widely Used in Traveling Cranes. *Steel*, Vol. 87, Aug. 28, 1930, pages 52–53.

Describes crane of 10-ton capacity built by the Northern Engineering Works for the sheet mill of the United States Aluminum Co. at Alcoa, Tenn. Span is 76½ ft. between truck wheels. Lift of hoisting hook is 25 ft. Bridge is of latticed-type girder construction and is made of No. 17 ST Al alloy rolled sections. Trucks are No. 195 Al alloy castings. The trolley, electrical fittings and many other parts are also made of Al. Total weight with trolley is 30,000 lbs. Made of steel it would weigh 77,100. MS(9)

Chrome Steel Doors Guard Wall Street Securities. *Steel*, Vol. 87, Aug. 28, 1930, pages 46, 56.

Vaults and vault doors are made up of cast-steel, 5-ply Cr steel, hardened and drill proof, open-hearth steel, infusite (a Cu-Fe alloy possessing high torch-resisting qualities) hard chemical plates and polished finish plates. MS(9)

Large Uses of Steel in Small Ways. *Steel*, Vol. 87, July 10, 1930, page 52; July 24, 1930, page 48; Aug. 7, 1930, page 52; Aug. 21, 1930, page 59; Sept. 4, 1930, page 62; Sept. 18, 1930, page 64; Oct. 2, 1930, page 54; Oct. 16, 1930, page 58; Oct. 30, 1930, page 60; Nov. 13, 1930, page 65; Nov. 27, 1930, page 54; Dec. 11, 1930, page 64; Dec. 25, 1930, page 52.

Deals with cotter-pins, bell-buoys, lightning-arresters, jacks, engine foundations, time-recorders, traffic markers, picks, industrial lighting reflectors, water-towers, miniature golf, access units and cameras. MS(9)

The Welded Siemens-Betz Propeller Fan. (Der geschweisste Siemens-Betz Schraubenlüfter.) *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 76–77.

The whole fan (except motor) with housing is made up of welded parts. Ha(9)

Alloy Steels Here to Stay. *Railway Age*, Vol. 87, Nov. 30, 1929, pages 1299–1300.

A general review of the use of alloy steels such as chromium, vanadium, nickel and nickel-chromium for locomotive forging boiler tubes, etc. VVK(9)

Steel Castings as Machine Parts. R. A. BULL. *Machine Design*, Vol. 3, May 1931, pages 37–40.

Desirability of full coöperation between designer and foundryman is emphasized. Some inherent weaknesses in castings due to incorrect design are cited and illustrated and suggestions are offered for improvement in the finished part. Ha(9)

The Modern Ornamental Iron Worker and Gas-Welding. (Der moderne Kunstschlosser und die Gasschmelzschweissung.) H. CASSE. *Die Schmelzschweissung*, Vol. 10, Apr. 1931, pages 89–90.

It is shown how artistically gas-welding can be applied in ornamental iron work. Ha(9)

Aluminum Alloys Containing Nickel. W. C. DEVEREUX. *Brass World*, Vol. 27, Feb. 1931, pages 31–35.

The manufacture and application of "Y" and "RR" alloys are outlined. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 39. WHB(9)

Wrought Iron Boilers for Hot Water and Low Pressure Steam Heating Plants. (Schmiedeeiserne Heizkessel der Warmwasser- und Niederdruckdampfheizungen.) E. KALISCH. *Die Schmelzschweissung*, Vol. 10, Mar. 1931, pages 58–60.

The advantages of wrought iron for boilers are discussed and a few examples described. Ha(9)

Alloy Forgings Have Wide Application. A. L. HAMILTON (Midvale Co.). *Steel*, Vol. 87, Dec. 11, 1930, pages 43–46.

Most of the large solid and hollow alloy steel forging development has been confined to the oil, power, chemical and pressure process industries. Tabulates many of the applications of the past 10 years. Many compositions are available, the approximate analyses of the steels that are melted, cast and forged, machined and heat-treated by the Midvale Co., being tabulated. Principal alloying elements are V, W, Cr, Ni and Mo. Forgings of C steel still have a place, particularly in many industries where early obsolescence of design is met. The Midvale Co. uses 50–85 ton open-hearth and 100, 500 and 1000 lb. Ajax-Northrup high-frequency furnaces. MS(9)

Principal Metallurgical Products Used in the Aeronautical Construction. (Principaux produits metallurgiques utilises dans la construction aeronautique.) G. R. HANNEL. *Aciers Speciaux, Métaux et Alliages*, Vol. 5, Dec. 1930, pages 550–558.

Most of the special steels used in aircraft contain: Ni, Cr, Si, Mo, W, Co, Al. Cr and Ni-Cr steels are preferably used for cylinders and for nitrided cylinders a Cr-Al or Al-Cr-Mo steel is used. A 14% W or high Cr steel is used for valves. Most of the light alloys used are Alpax, "Y," and duralumin. GTM(9)

The Use of Non-Ferrous Metals in the Aeronautical Industry. D. HANSON. *Journal Institute of Metals*, Vol. 44, No. 2, 1930, pages 5–28.

See *Metals & Alloys*, Vol. 2, Apr. 1931, page 81. (9)

Hollow Steel Propeller New Development for Airplanes. W. G. GUDE. *Steel*, Vol. 87, Nov. 27, 1930, page 56.

Hamilton Standard Co. uses a tube for blades, while the Pittsburgh Screw & Bolt Corp. welds together 2 steel plates. The latter uses SAE 6130 Cr-V steel. New type of hub design eliminates considerable weight without loss of strength. Steel can be placed where greatest stresses occur in blade. Due to the stiffness of the steel blade near the tip, there is less distortion when in flight than in the solid metal blade. Ultimate strength of Cr-V steel is 100,000 lb./in.^{2}, respectively, for age-hardened Al alloy. Most of the pitting and erosion now encountered in seaplane service with Al alloy blades will be eliminated. MS(9)

Rolled Steel Floor Plates are Finding New Uses. E. C. KREUTZBERG. *Steel*, Vol. 87, Sept. 18, 1930, pages 56–57, 59.

Describes installations of floor plates in buildings, boiler-houses, factories, bridges and the railroad field. MS(9)

Steel Is Accepted Material for Hangar Construction. K. B. LANSDOWNE. *Steel*, Vol. 87, Dec. 4, 1930, pages 61–62.

Steel hangar has become standard in the aviation industry. Problems encountered are in the field of design. Principal problem is that of neutralizing or avoiding wind pressures while placing aircraft in their stowage places. Describes several recently built structures. MS(9)

World's First Metal-Base Highway Built of Pure Iron. TRUMAN L. FLAT. *The Pure Iron Era*, Vol. 3, 1930, pages 4–5.
An experimental stretch of highway near Springfield, Ill., was paved with a metal base of Armco Ingot Iron of 10 gage corrugated sheets welded on each end and twice on each side. A mastic sand cushion is laid on the iron base and then bricks laid, rolled and asphalt filler applied. Ha(9)

Uses of Aluminium in Shipbuilding. PAUL V. FARAGHER. *Engineering*, Vol. 130, Dec. 19, 1930, page 770.
Abstract of paper read before the American Society of Naval Architects and Marine Engineers, Nov. 1930. For general use on ships, alloy is recommended which contains Cu 4.0, Mn 0.5 and Mg 0.5%. Most effective coating for preventing corrosion is Al paint made by adding Al bronze powder to a vehicle such as oil varnish. LFM(9)

Welded Aluminum in Tank Trucks. W. M. DUNLAP. *Welding*, Vol. 2, June 1931, pages 384–385.
The use of aluminum alloy instead of steel is of enormous advantage in transporting and delivering. The lighter weight makes a greater capacity possible, so that in spite of the price being about double that of steel, about $20 per day is saved which balances the initial loss in about 150 days. Tests and the choice of materials are discussed. Ha(9)

Metallizing the Airplane. H. V. THADEN. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, 1930, *Aeronautical Engineering*, pages 167–172.
Includes discussion. The paper gives advantages and disadvantages of metal construction for airplanes. See "More Metal Being Used in Planes," *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. (9)

Saving Tonnage in Cruisers. LEWIS H. FAWCETT (U. S. Naval Gun Factory). *Metal Progress*, Vol. 19, Apr. 1931, pages 39–43.
The author describes the application of light alloys and stronger materials of lighter section to the construction of naval ships resulting in substantial savings in weight. Use of aluminum paint results in an appreciable saving in weight. WLC(9)

Improvements in Welding Technique for Pipe Lines in the Building Trade. (Schweisstechnische Neuerungen für Rohrbau im Baugewerbe.) P. THELEN. *Die Schmelzschweissung*, Vol. 9, Aug. 1930, pages 189–192.
Some applications of welding in sewer, water and gas lines in buildings are illustrated which permit a better adaptability to the available space and also a saving in space. Ha(9)

Recent Hand Work in Iron. (Neuzeitliche Handarbeiten in Eisen.) C. TUPHOLME. *Die Schmelzschweissung*, Vol. 9, Sept. 1930, page 217.
A few artistic decorations, chandeliers, etc. Ha(9)

Copper Pipe for Water Lines. (Kupferrohr für Wasserleitungen.) Contribution from the German Copper Institute. *Metallwirtschaft*, Vol. 10, June 5, 1931, pages 461–464.
The advantages of copper over steel pipe for drinking water and hot water lines are described. They include freedom from rusting, greater resistance toward chemical attack from the soil and sand, better resistance against breakage due to freezing on account of high ductility of copper, lower resistance to the flow of water on account of freedom from rust. For these reasons pipes of smaller diameter and wall thickness can be used and the cost of copper pipe becomes less than iron. Connections made by hard soldering or brazing offer no difficulties. CEM(9)

Homes of Metal. *Metal Progress*, Vol. 20, July 1931, pages 89–94.
Development of the use of metal in domestic construction is described and discussed. WLC(9)

Unusual Steel Flooring Designed for Saving Weight. *Iron Age*, Vol. 127, April 2, 1931, page 1089.
Describes pier constructed by the Erie Railroad in Weehawken, N. J., carrying 3 stories of storage and warehousing facilities on a foundation designed for only 2 stories. Pier is a steel frame, fireproof structure of 739 ft. by 97 ft. wide, supported on untreated timber piles. A complete description may be found in a recent issue of *Railway Age*. VSP(9)

Use of Acetylene Welding in the Construction of Automotive Street-Cleaning Vehicles. (Anwendung der Azetylenschweissung beim Bau von automobilen Strassenreinigungs-Fahrzeugen.) WILLENBACHER. *Autogene Metallbearbeitung*, Vol. 23, Aug. 15, 1930, pages 250–253.
A few illustrations of vehicles built by Keller & Knappich, Augsburg. Ha(9)

Aluminum Foil Tried on Car Roof. C. P. WESTLAKE. *Electric Railway Journal*, Vol. 75, Mar. 1931, page 153.
The tops of trolley cars were covered with 0.004" aluminum foil, applied with a foiling adhesive painted on the canvas top. Service since August 1930 indicates complete satisfaction as regards weather resistance, and a cooling effect in reducing the effects of the sun's rays. WHB(9)

Prospects of the Copper Industry. WILLIAM A. WILLIS (Copper & Brass Research Association). *Mining Congress Journal*, Vol. 17, Jan. 1931, pages 6–7.
Points out modern trend for using copper in building and exterior construction. Illustrates internal and external applications already installed in German buildings. DTR(9)

Steels for American Automobiles, Model 1931. J. M. WATSON (Hupp Motor Car Corp.). *Metal Progress*, Vol. 19, Feb. 1931, pages 33–37.
A paper presented before the Western Metal Congress in San Francisco, Feb. 16, 1931, and to appear in greater detail with discussion in the Transactions. After suggesting the advantages of a small number of different steels in an automobile, the author discusses under the headings of various parts of a car the steels specified for such parts. Ten important parts of the automobile are discussed at length with specifications as to composition and heat treatment for their production. Some 60 steels and their applications are mentioned. WLC(9)

Uses of Nickel. A. J. WADHAMS. *American Metal Market*, Vol. 37, June 6, 1930, pages 3, 4.
An outline. WHB(9)

Reducing Wear at Base-Metal Contacts. J. R. TOWNSEND. *Bell Laboratories Record*, Vol. 9, Nov. 1930, pages 124–126.
The fairly rapidly wearing brass terminals and brushes of a dial telephone apparatus were replaced by a 5% tin-phosphor-bronze which resulted in a five-fold improvement. Ha(9)

A New Oil-Less Bearing Metal. W. C. WILHARM. *Electric Journal*, Vol. 27, Sept. 1930, page 553.
A self-lubricating bearing metal with a life 10 times that of previous "oil-less" bearings has been developed. It should find application where bearings are used which require short-time operation and infrequent attention as in starting mechanisms. It depends for its low coefficient of friction upon the soap it contains. Powdered metals, such as copper, lead and zinc are thoroughly mixed with some fatty acid. Exceedingly high pressures and elevated temperatures, used in the molding process, result in the formation of a solid metal which is not porous and presents a good surface for an oil film to form and be maintained on. This new material is still in the development stage, but obviously has interesting possibilities. WHB(9)

HEAT TREATMENT (10)

Heat Treatment in Fused Salt Baths. W. J. MERTEN. *Houghton's Black & White*, Vol. 3, May 1931, pages 11–12.
General remarks on the possible chemical reactions between bath and steels whereby gases are formed which diffuse through the metal. Really neutral heating in gases is still an unsolved problem. Ha(10)

Heat Treatment Adds Mileage to Rolled Steel Wheels. R. W. STEIGERWALT. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 37–39.
The Carnegie Steel Company has developed "rim-toughened wheels," using a special heat treatment consisting of heating the wheels to the proper temperature to refine the grain and then rotating the rim of the wheel in water and immediately tempering it to take out any possible strains. Microphotographs show the structure. Ha(10)

Report of Committee A-4 on Heat Treatment of Iron and Steel. *American Society for Testing Materials, Advance paper* No. 12, June 23–27, 1930, 2 pages.
The committee recommended that tentative definitions of terms relating to heat-treatment operations, especially as related to ferrous alloys (A 119–28 T), be slightly revised as indicated. It was also recommended that definitions as revised be advanced to standard. (10)

Heat-Treatment of Grey Cast Iron. R. WHITFIELD. *Foundry Trade Journal*, Vol. 42, June 19, 1930, pages 455–457, 459.
Includes discussion extracted from paper before Sheffield section of Institute of British Foundrymen. Three general types of heat treatment used for gray cast iron: (1) Heating at low temp. (not over 540° C.) to relieve internal strains; (2) heating above critical range to relieve strains and increase machinability; and (3) heating above critical point followed by an oil quench. Contains discussion of the heat treatment of various Fe castings, pearlite Fe, soaking and cooling and batch type casting annealing furnace. VSP(10)

Some Phases of Heat Treatment of Cylinder and Alloy Irons. F. J. WALLS & A. HARTWELL, JR. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Mar. 1931, pages 865–896.
Tests were run to determine the relief of stresses in cylinder irons on heating to temperatures of 750° to 1150° F. The hardness of the irons as affected by air, water and oil quenching was investigated. Maximum relief of stresses is obtained with minimum growth and change in hardness by heating to 950° F. followed by slow cooling. Similar tests were made on Cr-Mo and Cr-Ni-Mn cast irons. CHL(10)

Heat Treatment of Railroad and Street Car Rails. (Les traitements thermiques des rails de chemins de fer et de tramways.) H. VITEAUX. *Revue de Métallurgie*, Vol. 28, Apr. 1931, pages 209–225.
To the Neuves-Maisons and Hagondange processes for heat treatment of rails described before (*Revue de Métallurgie*, Feb. 1926 and Jan. 1927) could be added Chadrine process in which the head of rails is sprayed with water from a long narrow slit, Duisburg process which does not present anything new (*Stahl und Eisen*, Oct. 1927), Maximilian Hütte method in which the head of rails is immersed in rapid stream of water and Kenney method used by Bethlehem Steel Co. where the rails leaving the shears are quenched for 30 sec. in water and immediately after placed into a drawing furnace kept at 850–1000° F. To these can be added the usual heat treatment of already cooled rails which was tried many times with complete success but was abandoned on account of the cost. For the usual composition of rails the sorbitizing treatment produces an increase in elastic limit and tensile strength of about 30–40% and a decrease in elongation of about 15%. Their impact value is increased. In case of Maximilian Hütte treatment the head of rail becomes martensitic to the depth of about 10 mm. with corresponding loss in ductility, which is still amply sufficient for impact specifications. Repeated impact test made on treated and untreated rails made of the same ingot and subjected to Neuves-Maisons process showed 3493 and 10,766 impacts, respectively. This represents an average of 25 rail heats. Stanton-Cambridge machine with a sharp notched test bar was used. Reports available from New South Wales railways show the wear of sorbitized rails to be about one-half of non-treated. Victoria railways report much longer life of the treated rails. Japanese State railroads have figures showing a 20% longer life for treated rails. French data show that while on normal track the difference in performance between treated and untreated rails is slight, in the areas where much braking and sliding takes place the former are much better. In one case a wear of 12-14 mm. in 3 years and 9 months for untreated rails was reduced to one millimeter in 10 months for treated. Treated rails do not have any particular resistance to cracking, but those already cracked show a better resistance to fracture than the untreated. Their advantage increases proportionally to the severity of the conditions under which a rail is working. Crushing of head is beneficially affected by increased elastic limit, i. e., by heat treatment. A large series of experiments conducted on French Northern railroads is not completed but already shows that the rails, even perfectly sound and not brittle, are susceptible to transverse fissures which are produced by sliding of wheels; thermal treatment appears, if not to eliminate them, at least to reduce considerably the speed of their propagation. (After presentation of the paper and before its publication these experiments were completed substantiating entirely the above expressed views.) JDG(10)

Hardening (10a)

Modern Tool Steels. J. A. HOPKINSON. *Automobile Engineer*, Vol. 19, Dec. 1929, pages 499–500.
Discusses the possibilities of error in the working of tool steel. High speed steel for tools should be hardened at 1300° to 1340° C. Steels containing from 5 to 10% Co require the higher temperature. Tempering should be done about 600° C. for 20 min. Co improves the wearing qualities especially when used at red heat. C should range from 0.65 to 0.80% depending upon the use of the tool. Diamond alloy steel contains 1.30 to 1.40% C, 5% W and small percentages of Cr and V. It is hardened in water at 800° to 810° C. Discusses production of dies and proper uses of tool steels. RHP(10a)

Metal Surface Hardening. A. E. SHORTER. *American Machinist*, Vol. 73, Nov. 22, 1930, pages 186E-189E; *Iron & Coal Trades Review*, Vol. 121, Nov. 14, 1930, page 725.
See *Metals & Alloys*, Vol. 2, May 1931, page 103. (10a)

Standardizes Process of Hardening Screws. J. W. MARSHALL. *Iron Age*, Vol. 126, Dec. 25, 1930, pages 1923–1924, 1977.
Five outstanding facts in maintenance of uniformly heat treated products are: the steel used; temperature of each treatment to be the same; length of time the work is in the furnace; time work is in the air; and temperature of cooling medium to be always the same. Gas is used as heating medium. Each charge is weighted before being put in the furnace. Charges run for about 90 min. at temperature of about 1650° F. and it is held within 10°. Oil is used for quenching. Work is drawn and tempered to temperatures up to 1200° F. in electric Homo furnace. After heat treatment, the work is Rockwell tested. This procedure is followed at the plant of the Allen Mfg. Co., Hartford, Conn. VSP(10a)

Annealing (10b)

Fundamentals of Copper Wire Annealing. O. S. HASKELL. *Wire & Wire Products*, Vol. 6, June 1931, pages 220–222.

The paper gives the results of experiments of the General Electric Co. to determine the furnace which is best suited for annealing copper and for obtaining a clean, non-oxidized product requiring no pickling or wiping. Continuous furnaces, batch-type furnaces, hood furnaces and Kenworthy furnaces are discussed and production data is cited. Ha(10b)

Electrical Annealing Installations in the Metal Industry. (Elektrische Glühanlagen in Metallwerken.) K. TAMELE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 28, 1931, pages 383–387.

The various forms of electric resistance furnaces, as they have been developed for heat treatment of metal products are briefly discussed and their operating properties explained. Descriptions are given of several examples of furnaces for pre-heating aluminum, brass plates for annealing of brass ribbons and wire coils. The factors determining the selection of furnaces are discussed. They include safety of operation, heat insulation, capacity of furnace, energy for heating up and type of furnace. It is shown that electric annealing is more economical, the more it is used in a plant. Ha(10b)

Case Hardening & Nitrogen Hardening (10c)

Carburizing with Propane. O. J. WILBOR & J. A. COMSTOCK. *Metal Progress*, Vol. 1, Oct. 1930, pages 99–100.

Paper presented before the 12th annual convention A. S. S. T. The reactions of the various gases H_2, CO, CO_2, O_2, N_2, steam and the hydrocarbons on steel are considered. The application of propane (C_3H_8) to carburizing, particularly by the "intermittent surge" method is described. Propane is admitted to the retort from a pressure source for a few seconds followed by a quiescent period of several minutes. Alternate purges of wet CO_2 can be used if desired to oxidize the soot and prepare the steel surface for further absorption of carbon. WHK(10c)

Recent Developments in Gas Carburization. O. J. WILBOR & J. A. COMSTOCK (Peoples Gas Light and Coke Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 533–551.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The authors discuss the use of city gas in carburizing, bright annealing and heat treatment of steel. An intermittent surge method of carburizing is described and its merits discussed. Data obtained by this method are tabulated. The method may be used to obtain any character of case desired. WLC(10c)

Nitriding of Iron and Iron Alloys. *Foundry Trade Journal*, Vol. 44, Apr. 30, 1931, page 312.

An abstract of an article by W. Eilender and O. Meyer (*Archiv für das Eisenhüttenwesen*) dealing with results of experiments carried out with electrolytic iron, four carbon steels, and a series of alloy steels—chromium, 14.51%; molybdenum, 8.16%; aluminum, 7.50%; and vanadium, 3.0%. The effects of temperature of treatment, time of treatment, etc., were considered and are dealt with in the article. OWE(10c)

Association of German Industrial Engineers. (Arbeitsgemeinschaft deutscher Betriebsingenieure. Mechanische Oberflächentechnik.) *Oberflächentechnik*, Apr. 7, 1931, page 82.

An abstract from the transactions of the meeting of the Association of German Industrial Engineers held on Jan. 22, 1931, in Berlin. In discussing the mechanical treatment of surface of steels, Ing. Prachtl brought out a new surface hardening process termed the Double-Duro-Process and developed by German tool steel makers. According to the process, the acetylene gas from a high pressure producer is mixed with oxygen and directed as a wide flame, 6–8 mm. long, against the steel object. The latter coming into contact with flame is immediately quenched by cool water sprayed on it through the 2 nozzles located under the burner. The depth effect is dependent upon the velocity of rotating the object. Especially suited for this process are steels containing carbon, chromium, molybdenum and silicon. ER(10c)

Correct Carburizing Practice. H. C. DECKARD. *Houghton's Black & White*, Vol. 3, Jan. 1931, pages 18–23.

Describes the manner of hardening a few pieces having complicated shapes. Ha(10c)

Nitriding the Larger Forgings. J. H. HIGGINS (Camden Forge Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 523–532.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The author describes and discusses the application of nitriding to large forgings. WLC(10c)

Case Hardening versus Nitriding. GEO. M. ENOS. *Modern Machine Shop*, Vol. 3, May 1931, pages 16, 20, 22, 24, 26, 28, 30.

The 2 processes are defined as follows: Case hardening is the process of carburizing and subsequent hardening, by suitable heat treatment, of all or part of the surface portions of a piece of iron-base alloy. Nitriding is the process of heating an iron-base alloy in contact with a source of nitrogen at a temperature such that the nitrogen content at or near the surface of the steel will be materially increased, thus securing great surface hardness. The 2 methods and the equipment necessary for each method are described. The structure of the metals is shown in microphotographs. Tables show which of the methods should be employed for a given alloy, how to heat treat it and what can be obtained by it. Ha(10c)

The Modifying Action of Ferrosilicon upon the Carburizing Process. E. G. MAHIN & F. J. MOOTZ. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 552–583.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion and 23 references. The restraining influence of ferrosilicon is further checked. Elementary silicon, magnesium-silicon and ferroboron act in the same way. Addition of silicon to the surface layers is shown. Ferro-silicon removes H_2S which is thought to act as a catalyzer of the carburizing reaction. In discussion the author states that the influence of H_2S was only observed late in the investigation and more data must be obtained to clear up the question of the influence of this gas. WLC(10c)

Carburizing for Depth. J. B. NEALEY. *Industrial Gas*, Vol. 9, Mar. 1931, pages 10–12.

The Tool Steel Gear & Pinion Co., Cincinnati, Ohio, uses a special method for carburizing steel parts up to 3000 lbs. to depths from $^3/_{16}$ to $^1/_4$ in. The modern installation for handling of alloy and low carbon steel is described. Ha(10c)

Carburizing with Gas in Underground Retorts. W. F. MCNALLY (New Process Gear Co.). *Metal Progress*, Vol. 19, Jan. 1931, pages 39–43.

The disadvantages of solid carburizing in equipment overhead, handling charges and space are enumerated. Experiments with the use of gas started in rotary retort using first city gas and later air-propane mixtures are reported. Air-propane mixture of 60% to 40% gave desired results illustrated by micrographs. Additional micrographs illustrate the cases obtained using city gas, natural gas and solid compound. By completely dehydrating city gas and maintaining 15 lbs. gage pressure in the retort successful carburization was obtained. A battery of pit furnaces with a heat exchanger for heating cold charges from the waste heat of previously carburized work is described. The advantages of this method of carburizing are reported. WLC(10c)

Relation of Structure to Surface Hardness of a Case Hardened Steel. H. W. MCQUAID & O. W. MCMULLAN. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 584–600.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Included discussion. The authors report on the non-agreement of file hardness with other hardness tests on carburized material. A study of the influence of the condition of the carbide is reported. It is shown how, at will, file hardness and low Rockwell, or vice versa, can be produced. In discussion A. L. Boegehold confirms this failure of file and other tests for hardness to agree on carburized work. WLC(10c)

The Nitriding Process. *Vancoram Review*, Vol. 2, Apr. 1931, pages 47–50.

Nitriding steels containing Al and Cr are the common types, but rough surfaces and poor transverse properties come with the use of Al. Use of Mo improves the ductility of the case, and avoids temper brittleness of the core so that Mo is now a regular constituent. A steel without Al, but containing 8% Cr, $1^1/_2$% Si and 0.70% Mo is said to give good results, but is expensive. The low alloy Cr V steels (S. A. E. 6100 series) with 0.20 to 0.60% C give tough nitrided cases of 750–800 Brinell, and solve many engineering problems at a low cost. High C, high Cr steels with both Mo and V have a higher core hardness than the Al steels, and such nitrided steels are suggested for ball bearings, rolls and drawing dies. Some attention is being paid to nitriding for corrosion resistance (against other than acid conditions) rather than for hardness. HWG(10c)

Nitriding Steel Parts. *Automobile Engineer*, Vol. 20, Oct. 1930, pages 381–382.

Description of a furnace developed by Leeds & Northrup Co. This furnace is electrically heated. RHP(10c)

The Structure of the Case in Cyanide-Hardened Steel. W. HENNINGER & H. JURICH. *Engineering Progress*, Vol. 11, Nov. 1930, pages 297–298.

The presence of eutectoid and needles can be detected in straight low-carbon steel treated in the cyanide bath for 5 hr. and cooled slowly when etched with hot concentrated sodium picrate solution. See also *Metals & Alloys*, Vol. 2, Feb. 1931, page 40. RHP(10c)

Modern Case Hardening Practice. F. W. ROWE. *Journal West of Scotland Iron and Steel Institute*, Vol. 38, 1931, pages 27–42; *Heat Treating & Forging*, Vol. 17, Apr. 1931, pages 372–373.

A résumé of the case hardening practice is presented. The subjects discussed are: (1) the choice of steel for case hardening, (2) "abnormality" in case hardened steels, (3) the case hardening of carbon steels, (4) the case hardening of alloy steels, (5) furnaces for case hardening, (6) compounds, (7) heat treatment after carburizing, (8) quenching media, (9) nitrogen hardening. Each subject is discussed in some detail, from a standpoint of elementary facts, as well as important facts to be remembered in successful case hardening. The article is too lengthy to abstract well; it should be consulted. WAT(10c)

Further Investigations in Nitriding. R. SERGESON & H. J. DEAL. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 474–501.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1931. Includes discussion. The authors in 3 sections discuss, first, container material with the conclusion that carbon steel enameled provides a low cost container of excellent properties; second, corrosion resistance, nitrided material is not resistant to acid action but is excellent for alkali, atmosphere, crude oil, ethyl gasoline, natural gas combustion products, tap water, and still salt water; and third, denitriding. Denitriding has been studied and is not so simple as suggested by Merten. In discussion the question of containers is further covered by J. H. Higgins (Materials Engr., Camden Forge Co., Camden, N. J.), J. P. Walsted, (M. I. T.) and A. B. Kinzel (Union Carbide). WLC(10c)

Nitriding in Packing Materials and Ammonia. A. B. KINZEL & JOHN J. EGAN (Union Carbide & Carbon Research Labs.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 459–473.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The application of inert packing materials such as magnesium, copper, and previously nitrided steel in ammonia nitriding is described. The advantages of shorter time for a given case depth, greater uniformity, and equally good results with chrome-aluminum and chrome-vanadium steels. In discussion Mr. Robert Sergeson, Republic Steel Corp., brings out the question of the time required for packing and for heating and cooling the greater mass of material (packing material). WLC(10c)

Quenching (10d)

The Selection of Quenching Media. H. J. FRENCH. *Houghton's Black & White*, Vol. 3, Jan. 1931, pages 4–7; Mar. 1931, pages 18–20; May 1931, pages 4–7.

In this series of articles, information is given and methods are discussed for the choice of cooling media, cooling rates, sources of variation in hardening, manner of cooling in liquids, critical cooling rates, carbon and alloy steels, manufacturing variables, size and shape of pieces to be treated, spray quenching and the control of flow in liquid baths. A great number of curves and tables illustrate the paper and supply practical data. Ha(10d)

A Note on the Formation of Nodular Troostite. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 19, Feb. 1931, page 88.

The writer reports results obtained by Mr. S. Sato with the self-recording dilatometer (described in January issue) offering an explanation for the formation of nodular troostite during the quenching of carbon steels. WLC(10d)

Aging (10f)

Hardness of Steel Changes with Age. Correspondence from E. W. EHN, Cannstatt, Germany. *Metal Progress*, Vol. 19, May 1931, pages 89–90.

Experiments and theories regarding precipitation hardening in steel are discussed. WLC(10f)

Recent Studies on the Aging of Aluminum Alloys. (Neuere Arbeiten über die Vergütung von Aluminiumlegierungen.) G. WASSERMANN. *Metallwirtschaft*, Vol. 10, Jan. 16, 1930, pages 47–49.

A review of the work of A. Portevin and P. Chevenard and of S. Kokuba and K. Honda on aluminum alloys published during 1930. CEM(10f)

Experiments on the Aging of Steel. (Versuche über das Altern von Stahl.) G. SACHS & W. STENZEL. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVII, 1931, pages 38–45.

See *Metals & Alloys*, Vol. 2, Apr. 1931, page 82. (10f)

Artificial Age-Hardening of Duralumin and Super-Duralumin. (Die künstliche Alterung von Duralumin und Super-Duralumin.) K. L. MEISSNER. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, page 64.

Arrives at the conclusion that, by means of artificial aging, some physical properties of Duralumin and Super-Duralumin may be improved, as for instance the yield point, but only at the expense of other valuable physical properties, such as elongation, resistance to deformation, etc.

See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. EF(10f)

JOINING OF METALS & ALLOYS (11)

Metal Joints in Aircraft Construction. T. Watson Downes. *Welding*, Vol. 1, Aug. 1930, pages 663–667.

A brief description of welding, brazing and soldering one or more materials by different welding processes. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. Ha(11)

Brazing (11a)

Brazed Joints for Electric Conductors. Samuel Martin, Jr. *Electrical Engineering*, Vol. 50, June 1931, pages 434–436.

Electrical resistance brazing produces in electric conductors joints which possess several distinct advantages over equivalent soldered joints and can be made at a lower cost. The equipment and process are described and comparative figures between the 2 types of joints are indicated. WHB(11a)

Brazed Connections Improve Power Transformer Quality. E. M. Glenn (Westinghouse Elec. & Mfg. Co.). *Electric Journal*, Vol. 28, June 1931, pages 367–368.

Brazing replacement of soldering has resulted in an increase in electrical conductivity and mechanical strength of the connections and has reduced the size of the joint. Phosphor-copper melts at 700° C. and the heating of brazing causes removal of most of the phosphorus insuring excellent electrical conductivity. Several illustrations are included. WHB(11a)

Copper Brazing in Hydrogen Electric Furnace. H. W. Webber (General Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1144–1159.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The author discusses a process developed by General Electric Co. for copper brazing of tungsten carbide tips to nickel steel shanks. WLC(11a)

Soldering (11b)

Resistance Soldering of Hard-Metal Tools. (Widerstandslötung von Hartmetallwerkzeugen.) A. Fehse. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, June 6, 1931, page 708.

Description of a small device for soldering small pieces of hard-facing materials, cutting edges of tools, etc., to the carrying piece by heating it electrically. Ha(11b)

Soldering of Aluminum. (Das Löten von Aluminium.) L. Rostosky & E. Lueder. *Aluminium, Hauszeitschrift, V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 150–159.

The Deutsche Gesellschaft für Metallkunde has investigated the soldering of aluminum and established the following distinctions: Soft solders consist of alloy with Zn or Sn base and other low-melting heavy metals, such as Cd, Pb, Bi; they contain no, or very little, Al up to about 20%. The Al hard-solders contain at least 70% Al; the remainder is made up of Cu, Ni, Ag, Mn, Sn, Zn, Cd, Sb, Si, Ce, etc. The resistivity of such a joint against air, water and steam is very low. The methods of application are described in detail and examples of soldered pieces are illustrated. Hard soldering is of particular advantage for thin sheets and for cast pieces. The refinable Al alloys, lautal and scleron, and other artificially hardened Al alloys, however, cannot be hard-soldered nor welded because their strength is reduced by heating to the required temperature by 50% or more. When this method is applied, consideration must be given the problem of whether or not the remaining strength is sufficient for the purpose in question. A table of solders, their use, preparation of the pieces, testing methods for soldered joints and resistance against corrosion is added. See also *Metals & Alloys*, Vol. 2, Mar. 1931, page 70. Ha(11b)

Welding & Cutting (11c)

Automatic Arc-Welding of Thin Sheets. (Selbsttätige Lichtbogenschweissung von dünner Blechen.) W. L. Warner. *Die Schmelzschweissung*, Vol. 9, Sept. 1931, pages 200–201.

Taken from *Iron Age*, Vol. 124, 1929, pages 834–837. Ha(11c)

Welded Framework of Steel Pipes. (Geschweisste Fachwerkkonstruktionen aus Stahlrohren.) Rud. Ulbricht. *Die Schmelzschweissung*, Vol. 10, Jan. 1931, pages 4–6.

The advantages of using pipes in welded steel structures instead of profiles are pointed out by examples actually built and described. Comparing ordinary structures built of profiles with pipe structures, a saving of from 30 to 35% in weight and a reduction in surface of about 48% could be obtained. The latter feature is especially important for reduction of cost in maintenance by painting. Ha(11c)

Results of Recent Researches in the Field of Autogenous Welding. (Neuere Forschungsergebnisse auf dem Gebiete der Autogen-Schweissung.) E. Wiss & Ph. Pothmann. *Forschungsarbeiten auf dem Gebiete der Azetylen-Schweissung*, published by the Deutscher Azetylen-Verein, Jan. 1930, pages 7–25.

This work was undertaken to determine the influences on the quality of a weld due to chemical conditions such as purity of the gases used, physical conditions, i. e., flame temperature, temperature of the molten part, reactions on the burner as well as metallurgical phenomena occurring in welding, the human factor, the best method of testing welding pencil material. All these individual tests are tabulated and illustrated in micro-photographs. Details must be looked up in the paper since this is only the beginning of a quite general research. 24 references (German, English, American) are included. Ha(11c)

The Arc Welder's Accessories. James M. Vossler. *Modern Machine Shop*, Vol. 3, Feb. 1931, pages 52–62, 67.

Details that, while generally accorded scanty attention may account for important wastes or savings, are discussed. MFB(11c)

Production Engineering. (Editorial abridgement of paper by) N. F. Ward. *S. A. E. Journal*, Vol. 28, Feb. 1931, pages 240–241.

After engineer in charge has decided upon type of weld and heat treatment, next task is to supervise and to keep a check upon the welding machine and operator. Causes of failure and their remedy for welding operations of different types are discussed. Subjects covered are zones of the oxy-acetylene flame; electric-arc welding; resistance welding; temperature stresses in welds; annealing needed to preserve strength; temperatures for resistance welding. MFB(11c)

Welded Construction Applied to Special Machinery. D. V. Waters. *Product Engineering*, Vol. 2, Apr. 1931, pages 167–170.

Illustrations of a special large buffing machine, a wire-tinning machine and a tinsel-serving machine. Some points to be observed, particularly in sheet welding, are emphasized. The allowable load on fillet welds per linear in. is given:

Size of Fillet	Allowable Load
1/4 × 1/4 in.	2000 lbs.
5/16 × 5/16 in.	2500 lbs.
3/8 × 3/8 in.	3000 lbs.
1/2 × 1/2 in.	4000 lbs.
5/8 × 5/8 in.	5000 lbs.
3/4 × 3/4 in.	6000 lbs.

Ha(11c)

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Welding Permits Production According to Design. J. P. WATERS. *Industrial Record*, Vol. 2, Mar. 1931, pages 25–27, 46–48, 61.
Detailed discussion of welding practice in a large plant manufacturing gas-operated domestic refrigerators. MFB(11c)

Gas-Welding Locomotive and End-Play Liners. F. R. WILLIAMS. *Welding*, Vol. 1, Aug. 1930, page 673.
The Canadian National Railway successfully uses gas welding to hold the liners in place. The procedure is described in detail. Ha(11c)

Regulations for Structural Welding in Germany. OTTO BONDY. *Iron Age*, Vol. 127, Apr. 2, 1931, pages 1074–1079.
Discusses structural welding development in Germany in the past 5 yrs. and gives regulations governing the erection of welded structures. Some of the requirements are that the location of welded seams to be made in the field should be marked in the shop. Methods may include arc welding, resistance welding or gas welding. For static calculation, design and execution the same principles hold good as for riveted structures. All welds must be easy of access for testing purposes. VSP(11c)

Electric Welding of Mild Steel by the Metal Arc Process. V. G. PEARSON. *Foundry Trade Journal*, Vol. 43, Aug. 21, 1930, pages 127–128.
Extracted from *Edgar Allen News*. The two greatest evils of welding deposit are porosity and slag inclusions. It is important to avoid steep walls when undercutting will take place. The training of operators is of paramount importance. Homogeneity of welds is discussed. VSP(11c)

Wider Adoption of Structural Welding Depends on Comparative Costs. A. F. DAVIS (Lincoln Electric Co.). *Metal Progress*, Vol. 19, Feb. 1931, pages 59–62.
Abstract of a paper presented before the Western Metal Congress, San Francisco, Feb. 16, 1931, and published in full with discussion in the Transactions of the American Society for Steel Treating. The author gives several examples of the expansion of welding in the construction of office and factory buildings. Uniformity and reliability of welded joints in structures are discussed with illustrations. Elimination of noise in erection and possible economies are the basis for the use of welding. Failure as yet to obtain real economies of cost in field erection has led to the use of welding to supplement riveting in shop fabrication of trusses and such. WLC(11c)

The Weldability of Aluminum Alloys as Dependent on the Type of Alloy. (Die Schweissbarkeit der Aluminium-Legierungen in Abhängigkeit vom Legierungstypus.) E. SCHEUER. *Die Schmelzschweissung*, Vol. 9, Aug. 1930, pages 178–182; *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 134–138.
The 3 most commonly used types of cast aluminum alloys are Al-Cu alloy (American alloy), Al-Cu-Zn alloy (German alloy) and Al-Si alloy (Silumin). Each of these is readily weldable to a different degree. The better weldability of the eutectic Al-Si alloy, as compared with the other two, is due to crystal structure and the solidification process. The German and American alloys are, before melting, brittle over a more or less extended temperature range because of melting of the eutectic "cement substance" between the aluminum crystals. Mechanical testing of the 3 alloys near the melting point by impact-bending tests showed the following:

Material	Temperature from Which an Impact Energy of 1.5 Mkg. Is Obtained	Reduction Point at Melting	Impact Energy at 5° C. below Inception of Visible Melting
	° C.		Mkg.
Silumin	3		1.5
American alloy	24		0.09
German alloy	45		0.07

The higher the temperature to which the material can be heated without destroying the plasticity, the better the hammer welding can be made. German and American alloys cannot be hammer welded because of their low eutectic temperatures and the resultant low plasticity, but silumin is suitable for this process and the welded seams show approximately the same strength as the normal soft silumin sheets, i. e., about 14 kg./mm.^{2} for autogenous welding and 16 kg./mm.^{2} for hammer welding. Ha(11c)

Gas-Welding of Heavy Plate Construction. O. A. DAVIS. *Welding*, Vol. 1, Aug. 1930, pages 693–696.
Describes some high-pressure tanks and kilns of large dimensions formed of welded plates. Modern shop equipment and good welding operators are essential to success. Ha(11c)

Electrically Welded Crane in Upper Silesia. (Elektrisch geschweisster Laufkrahn in Oberschlesien.) DECKE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Feb. 21, 1931, page 233.
A 10 ton, 19.2 m. span crane, entirely welded, was tested with 20,000 kg. (double load) and showed 32 mm. deflection ($^1/_{600}$ of the span) which disappeared entirely after the load was taken off. The weight of the crane is 3 tons less than that of an equal riveted crane and the cost is 20% less. Ha(11c)

Structural Welding, Its Present Status and Future Chances, J. E. FERGUSON (The Austin Co.). *Metal Progress*, Vol. 19, May 1931, pages 51–55, 108.
The author states that the reliability of properly welded joints has been proven the equal or superior of riveted joints in steel structures. Field erection, however, requires careful preparation and study of costs before undertaking. Various buildings and structures recently erected by welding are named. Advantages of welding are real and their value is becoming impressed on the minds of architects, engineers and construction companies. The factors essential to the future development of welded structures are discussed. WLC(11c)

The Strength of Arc Welded Joints. F. R. FREEMAN. *Engineering*, Vol. 131, Feb. 6, 1931, page 192.
Abstract of paper read before the Institution of Civil Engineers, Jan. 27, 1931. LFM(11c)

A Remarkable Welding of a Large Tank. (Eine bemerkenswerte Grossbehälterschweissung.) O. WUNDRAM. *Die Schmelzschweissung*, Vol. 9, May 1930, pages 122–125.
A large heat storage tank (10 m. in diameter, 35 m. high, of single sheet of 1.80 × 5.30 m. and from 20.5 mm. thickness at the bottom to 6 mm. at the top) for the central heating plant of the Hamburg Electricity Works was entirely lap welded. The erection was completed in 5 months (winter). The welding was done by direct circuit with 4 mm. electrodes and 165 amp., 40 volts. Ha(11c)

Influence of Welding Current Conditions with the Electric Arc Welding of Soft Steel. (Einfluss der Schweissstrombedingungen bei der elektrischen Lichtbogenschweissung von weichem Flussstahl.) N. LEFRING. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Feb. 21, 1931, pages 223–224.
The interrelation of melting conditions at electric arc welding and the influence on melting velocity of kind of current, polarity and kind of electrode are determined by experiments. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 41. Ha(11c)

Electrically Welded Pulleys. (Elektrisch geschweisste Riemenscheiben.) WILLIBALD SENFT. *Elektrotechnik und Maschinenbau*, Vol. 48, Sept. 21, 1930, pages 886–888.
Describes method of welding and compares costs of cast and welded pulleys. MS(11c)

Stresses in Materials Cut with Oxygen. (Materialspannungen bei Sauerstoffschnitten.) L. v. ROESSLER. *Autogene Metallbearbeitung*, Vol. 24, Mar. 1, 1931, pages 65–75.
It is shown that cutting with oxygen causes stresses in the material which can sometimes assume injurious values. A method is described by which these strains have been measured so that the magnitude and distance within which the stresses occur can be determined. If a material has been cut in the cold state, such stresses can be made to disappear by annealing. If cutting with oxygen is done on pre-heated material, no interior stresses remain. Ha(11c)

Lengthening Rails by Butt-Welding. L. C. RYAN. *Welding*, Vol. 2, Jan. 1931, pages 22–24
In railroad operation, rail joints are the primary cause of many service troubles; therefore, the elimination of as many joints as possible is now an accepted practice. While lengthening of rails up to 66 ft. has helped considerably, it is now urged to weld together stretches as long as 1000 ft. as it has been proven that expansion and contraction from temperature changes take place only in about 40 ft. at the end of any length of solid rail. The advantages from this method are pointed out especially in safeguarding and reducing costs of operation. See also *Metals & Alloys*, Vol. 2, Feb. 1931, page 39. Ha(11c)

Electrically Welded Tool Holders and Chucks. (Elektrisch geschweisste Messerhalter und Spannbacken.) SENFT. *Elektrotechnische Zeitschrift*, Vol. 52, Feb. 26, 1931, pages 297–298.
A few examples of multiple tool holders which could be made by welding at about 35% of the cost of cast steel pieces. Weight of the pieces was about 30 lbs. Ha(11c)

Arc-Welding for Structural Buildings, Tank Construction and Machinery. (Lichtbogenschweissung im Hoch-, Behälter- und Maschinenbau.) E. R. RUCK. *AEG-Mitteilungen*, May 1931, pages 323–327.
The advantages of arc-welding are shown on a few typical examples. Ha(11c)

Tenth International Acetylene Congress. E. DACRE LACY. *Welding*, Vol. 1, Nov. 1930, pages 915–918.
The congress was held in Zurich, Switzerland. 67 papers were read on subjects pertaining to the theory and practice of welding and metal cutting, and upon the aspect of oxygen and acetylene. The program of the congress and a brief résumé of some papers are included. Ha(11c)

Gas Welding Applied to Metal Airplanes. PAUL MCCOY. *Welding*, Vol. 1, Nov. 1930, pages 901–902.
Brief description of materials and methods used. Many of the parts are fabricated by welding including aluminum oil and gasoline tanks. Ha(11c)

Welding Inspection and Testing. R. KRAUS. *Welding*, Vol. 1, Aug. 1930, pages 668–673; Sept. 1930, pages 757–761.
The checking of the welders' ability and observation of the work in process are the outstanding ways of making inspection effective. By familiarity with the characteristics of good and bad welds, which are included in the paper, the inspector is assisted in judging the finished work while he has been observing each welder in turn in the group assigned to him. A variety of non-destructive tests for welded tanks are described. The soap bubble arc test in combination with a hot oil test is practiced for tanks made of thin materials, while high pressure oil tests are applied to tanks fabricated of plates. Numerous examples of laying out and carrying out the work and of the application of tests are illustrated. Ha(11c)

The Dynamic Characteristic of Welding Generators. (Die dynamische Charakteristic von Schweissstromerzeugern.) H. LANGKAU. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Feb. 28, 1931, pages 263–266.
The dynamic characteristic of the welding generator with self-excitation is that curve showing the behavior of terminal voltage at fluctuations of current (load) as they occur in practice. It is noted that the present machines are not yet perfect, in so far as the unfavorable dynamic characteristic and the low efficiency are due to the fact that the EMF does not respond properly. The machine should be much more sensitive at diminishing current and not, as at present, for increasing current. A desirable characteristic is derived. Ha(11c)

Welding with Atomic Hydrogen Process. SAM. MARTIN, JR. *Welding*, Vol. 1, Nov. 1930, pages 907–909.
A discussion of the fundamental principles of the process and its equipment, manner of functioning and the consumption of tungsten electrodes around which the molecular hydrogen is dissociated into atomic hydrogen. Curves illustrate welding current for different thicknesses of plates and the respective welding speeds. Ha(11c)

Outline of Welding and Allied Processes. F. L. LLEWELLYN (U. S. Steel Corp.). *Metal Progress*, Vol. 18, Dec. 1930, pages 95–104; Vol. 19, Jan. 1931, pages 51–56, 104–107.
The author defines welding and discusses surface conditions and source of heat. Special attention is given to the characteristics and interrelation of newer processes. Description of specific methods, forge welding, resistance, electropercussion, arc welding, gas cutting and thermit welding is given with discussion of the history and applications of these methods. Data on the heat treatment of welds and welded parts and their physical properties are given. Questions of cost and patent situations are discussed. A chart shows a classification of various processes and their applications. Study and development of the technique for every welding application are essential to good results and promise further growth of this method of fabrication. WLC(11c)

The Welding of Structures. H. MARTIN. *The Welder*, Vol. 2, Mar. 1931, pages 12–14.
A brief discussion of how a weld should be made. As working loads for lap welds the author gives the following figures with a safety factor of 4:

Size of Fillet	Tons/linear in. of weld (in longitudinal shear) Bare Wire	Medex	Cresta
$^1/_2$ in.	1.5	1.75	2.0
$^3/_8$ in.	1.33	1.5	1.8
$^5/_{16}$ in.	1.12	1.25	1.35
$^1/_4$ in.	0.75	1.0	1.2

The speed of welding is given as roughly proportionate to the electrical energy consumed in the arc, i. e., equal to volts × amperes. Where the work is exposed to weather or corrosive conditions, it should be sealed by welding from the atmosphere around every joint irrespective of the amount of weld metal necessary for carrying the load. Ha(11c)

The Design of Welded Steel Structures. Part IV. H. A. MCCREADIE. *The Welder*, Vol. 2, Feb. 1931, pages 3–6.
This installment deals mainly with the making of reinforcements to plates, girders, etc., and how they must be dimensioned. Ha(11c)

New Science of Welding Makes Great Changes in Industry. C. J. MCGREGOR. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 81–82.
A general discussion of welding and its applications. Ha(11c)

Welding and the Building Codes. F. P. MCKIBBEN. *Welding*, Vol. 1, Sept. 1930, pages 739–744.
A review of the building regulations in different states and a list of cities which have included welding in their codes. The qualifications for welders are also discussed. Ha(11c)

The Welding of Aluminium and Its Alloys. (Das Schweissen des Aluminiums und seiner Legierungen.) F. GOLDMANN. *Aluminium, Hauszeitschrift V. A. W. Ertfwerk*, Vol. 3, Apr.-June, 1931, pages 142–146.

A general discussion of welding methods for aluminum products (not cast aluminum), their particular qualities and advantages for certain purposes. The great possibilities of electric resistance welding is especially treated and a few machines for spot welding, butt welding and seam welding are illustrated. It is particularly pointed out that, due to the small mass of the heated metal and the quick cooling effect of the electrodes, the structure of the welded joint is not changed back to the cast structure and the solid solution is not disintegrated. The resistance-welding method is very good for quantity production. Hammer welding is expensive and gives a high grade of joint, but it requires special care and, therefore, is used only for valuable pieces. Ha(11c)

Physical Aspects of Structural Joints. JAMES R. GRIFFITH. *Welding*, Vol. 1, Aug, 1930, pages 678–680.

Welded connections should be designed to utilize the particular advantages of welding in order to eliminate some of the undesirable factors commonly found in a riveted joint. The author's conclusions are illustrated. Ha(11c)

Test Results of Welded Misco Joints. W. A. HAKIN. *Welding*, Vol. 1, Nov. 1930, pages 910–912.

Misco electrodes have the following composition: Ni 35%, Cr 15%, C 0.50%, Si 1.25%, Mn 0.70%, S 0.045%, P 0.045%, Fe 47.46%. This steel is a heat resisting alloy and is used for structural and mechanical parts operating at temperatures up to 2000° F. The method of calculation of the stresses in the fillets is given and some test results are reproduced. Ha(11c)

Changes of Material of Structural Steels Machined with the Cutting Flame. (Werkstoffveränderungen der mit Schneidbrennern bearbeiteten Baustähle.) A. HILPERT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 23, 1931, pages 649–652.

German rules and regulations often require that autogenously cut surfaces be machined (planed, milled, filed, ground, etc.), assuming that the cut surface has been weakened. Tests have proved that in the great majority of cases, properly made autogenous cuts do not require subsequent machining. The tests employed include tensile tests, folding tests, dynamic tests and examination of the cut surface. It would seem, therefore, that these rigorous rules might safely be modified with benefit to the manufacturer and the customer through savings in material and labor costs. Ha(11c)

Welded Steel Drums for Scout Cruisers. J. C. HODGE (Babcock & Wilcox Co.). *Metal Progress*, Vol. 19, Mar. 1931, pages 40–45.

A paper presented before the Western Metal Congress, San Francisco, Feb. 16, 1931, to be published in the Transactions with discussion. Determination of physical and chemical properties of representative welds, nondestructive examination by X-rays, and hydrostatic testing of finished vessels are the basis of specifications to insure good welded vessels. WLC(11c)

Repair Welding of Gears. (Reparaturschweissungen an Zahnrädern.) H. HOLLER. *Autogene Metallbearbeitung*, Vol. 23, June 1, 1930, page 173.

A few illustrations of successful welding of cast iron wheels. Ha(11c)

The Weldability of Aluminium. (Die Schweissbarkeit des Aluminiums.) H. HOLLER. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June, 1930, pages 123–133.

Discussion of welding to produce a joining between 2 materials which is technologically equivalent to the materials joined. This matter is discussed with regard to the development of the different methods of welding aluminum and the manner and limits of their application. Welding methods are supplemented by homogenizing. Welding can be replaced, to a certain extent, by soldering or riveting. With soldering, additional material of different elements is used; undesirable heating of the joint and neighboring zones (by cold riveting which finds its principal application for the refinable aluminum alloys whose joints must not be exposed to welding or soldering heat). Their welding methods and their particular qualities are described. Numerous illustrations and microphotographs illustrate welds which are satisfactory and those which are defective. Ha(11c)

Welding instead of Casting. (Schweissen an Stelle von Giessen.) H. HOLLER. *Autogene Metallbearbeitung*, Vol. 23, Oct. 1, 1930, pages 299–302.

Points out the many advantages which can be gained by welding together complicated forms from single parts instead of casting or riveting them. This is especially true if only one or a few pieces are required, since a costly pattern is saved. Ha(11c)

Research Covering Alternating Current Arc Welding. GROVER A. HUGHES & R. C. MCBRIDE. *Iron & Steel Engineer*, Vol. 8, June 1931, pages 241–246.

Results of the research are shown for welded steel, aluminum, Ascoloy, Monel metal, copper. Alternating current arc welding was found satisfactory as to tensile strength, ductility, rate of depositing metal, and current consumption. Efficiency of welders is high, and voltage and current curves are ideal. Satisfactory welds can be made with bare electrodes and with non-ferrous metals. WHB(11c)

The Action of Purifying Agents for Acetylene and the Influence of Contents of Phosphite and Sulphide of Hydrogen in Acetylene on the Welded Seam. (Ueber die Wirksamkeit von Reinigungsmassen für Azetylen und den Einfluss des Phosphor- und Schwefel-wasserstoffgehalts im Azetylen auf die Schweissnaht.) P. K. HOLZHAEUSER. *Autogene Metallbearbeitung*, Vol. 23, Sept. 1, 1930, pages 266–275; Sept. 15, 1930, pages 286–296.

Of all purifying agents, the most effective were found to be materials of calcium chloride; and after these, materials of bi-chromate; other materials for the purpose were less effective than either of these. Since dry gas cannot be purified, it is important that the gas not be dried before purification. Contents of 0.02 vol. % of hydrogen phosphide or 0.05 hydrogen sulphide are not harmful to the quality of the welded seam. Very careful tests and the arrangements necessary to making them are described and 28 references are cited. Ha(11c)

Stresses in Large Fillet Welds. CHAS. H. JENNINGS. *Product Engineering*, Vol. 2, Mar. 1931, pages 116–118.

A discussion of the magnitude and calculation of stresses in fillet welds leads to the conclusions that the larger the fillet, the greater is the probability of large residual stresses. The larger the fillet weld, the lower its yield point and ultimate unit strength in transverse bending. The ultimate strengths obtained were:

$^3/_4$ in. weld	43,500 lb./in.^{2}
1 in. weld	38,300 lb./in.^{2}
$1^3/_8$ in. weld	33,600 lb./in.^{2}

Welds located in several places close together should be welded simultaneously rather than successively in order to prevent excessive stresses in the first weld. Ha(11c)

How to Arc Weld Cast Iron Successfully. THOS. D. KETCHBAW. *Welding*, Vol. 1, Nov. 1930, pages 919–922.

Preheating is a most essential factor in successful welding of cast iron. Details of technique and cost figures for several interesting jobs are cited. Ha(11c)

Investigations of the Left Welding, Old and New Right Welding in Different Positions of the Work Piece. (Untersuchung über die Links, alte und neue Rechtsschweissung bei verschiedenen Stellungen des Werkstücks.) H. SCHAEFER. *Die Schmelzschweissung*, Vol. 9, Oct. 1930, pages 225–228.

For horizontal and vertical positions, the new right welding gave the best results with regard to consumption of gas, wire and time. For a less experienced welder, the old right welding is better. With some practice, this method can give almost the same strength as the new method. For overhead positions of the work piece, no noticeable difference between the three methods could be found, either for output of the welder or for consumption of gas and wire. Ha(11c)

Influence of Acetylene Pressures on the Quality of the Welded Seam. (Einfluss der Azetylendrücke auf die Güte der Schweissnaht.) K. GABLER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Jan. 17, 1931, pages 77–81.

An investigation was made to determine, for small shops or work in the field, whether low, medium or high pressure acetylene is more advantageous when the quality of the weld is the determing factor to be considered. Tests were made under practical conditions on sheets of 1000 mm. length, 100 mm. width and 10 mm. thickness. Analyses, gas consumption, mechanical and metallographical examination are reproduced in full. It is found that, under conditions as prevailing in small operations, dissolved acetylene is preferable to all other gases. Ha(11c)

Repairs of Gray-Cast Machine Parts by Gas Fusion-Welding with the Application of Special Bronze. (Reparaturarbeiten an Grauguss-Maschinenteilen mit Hilfe des Gasschmelzverfahrens unter Verwendung von Specialbronze.) A. GLATZEL. *Autogene Metallbearbeitung*, Vol. 23, Oct. 15, 1930, pages 325–328; Nov. 1, 1930, pages 334–336.

Several examples of successful repairs on gears, bearings, dynamo frames, etc. Ha(11c)

The Question of Time or Piece Work in Welding. (Zur Frage des Akkordschweissens.) H. MELHARDT. *Autogene Metallbearbeitung*, Vol. 24, May 1, 1931, pages 134–137.

Factors influencing the manner of paying for welding (whether by piece or time) are thoroughly discussed. That welders should do absolutely nothing but welding work, is emphasized. The welder must receive exact instruction as to what to do and how to do it. His work should be confined to welding—to weld as quickly, as well and as economically as possible. The shop foreman must care for arrangement of seam, preparation of sheets and sequence of welds. Directions as to gas pressure, size of flame, manipulating of welding rods, etc., should be given. Under these conditions, the good welder is easily recognized and a fair price for piece work can be made. Ha(11c)

The Metallurgy of Welded-on Overlays. MILES C. SMITH. *Welding*, Vol. 1, Aug. 1930, pages 681–683.

Hard facing is very often necessary; the characteristic properties and methods are discussed. In order to avoid stresses in the welded-on overlay, the preheating of the mother material is necessary, usually to a dull red heat. Microphotographs illustrate the proper amalgamation of the overlay and the fused material. Wear-resistant materials which may be used for such overlays are W, Zr, Cr, Mn and Si. Some of the characteristics of these materials are discussed. Ha(11c)

Fixtures and Dies for Flash Welding. W. E. SMITH. *Welding*, Vol. 1, Aug. 1930, pages 687–688.

Discusses some reasons for defective welds due to misalignment of parts, reduction of clamping pressure, wear of dies and considers means of avoiding them. Ha(11c)

Unfired Pressure Vessels. W. SPRARAGEN (American Bureau of Welding). *Industrial Gas*, Vol. 12, Mar. 1931, pages 10–16.

Application of fusion welding to fabrication of pressure vessels. This paper based on series of results of tests in 1923 under head of American Bureau of Welding with aid of U. S. Bureau of Standards, the Unfired Pressure Vessel Code of A. S. M. E. and experiences of others. Fundamental factors considered: (1) selection of material of good welding quality and use of good welding wire; (2) correct design of vessel and welded joints; (3) use of qualified welders; (4) proper preparation of material for welding; (5) employment of proper technique; (6) testing of finished vessel. DTR(11c)

Influence of Magnetism on the Welding Arc. R. M. STEPHENS. *Welding*, Vol. 2, June 1931, pages 369–371.

The magnetic fields set up between electrode and work piece and their effect in blowing out the arc or making it unsteady under certain conditions are explained. Several schemes have been developed to overcome these magnetic effects and to insure a resulting magnetic field of proper direction and magnitude. A few of these methods are illustrated. Ha(11c)

Responsibilities of the Welding Engineer. ROBERT E. STORM. *Welding*, Vol. 1, Oct. 1930, page 849.

Advocates the services of a competent specialist to advise in welding problems. Ha(11c)

Stresses in the Sheet and Welded Seams in the Construction of Pipe Lines and Tanks. (Blech-und Schweissnahtspannungen im Rohrleitungs- und Behälterbau.) H. SCHAEFER. *Die Schmelzschweissung*, Vol. 9, July 1930, pages 159–161.

Means are discussed to eliminate or at least diminish the heat stresses occurring in autogenous welding by proper selection and arrangement of the seam. Good heat conduction is always of importance so that no overheating at single spots can take place. Certain directions can be given from experience for the welding of cover plates, flanges on pipes and high pressure tanks. Ha(11c)

The Combined Autogenous-Electric Welding Process, "Arcogen." (Das kombinierte autogen-elektrische Schweissverfahren "Arcogen.") H. MUENTER & E. WISS. *Autogene Metallbearbeitung*, Vol. 23, Nov. 15, 1930, pages 349–356; Dec. 1, 1930, pages 365–373.

This new method combines the advantages of autogenous welding, which gives welds of very good elongation, with that of arc welding, which produces but very small heat stresses and is, therefore, especially suitable for welding complicated pieces. The gas-technical and the electrical phenomena of the combined process are discussed and the manipulation of electrode and flame is described in detail. The tests on welded pieces by tensile, bending and metallographic methods proved that this method can be applied, not only for steels and iron but also for copper and aluminum. Materials which are sensitive to overheating and which burn readily are adaptable to this method. Illustrations are given of built-up welding, butt welding, overlap welding, etc. The velocity of welding by this method is about 50% higher than that for gas welding. A comparison of economy shows about 30% in favor of the "Arcogen" method. The discussion of this paper supplements it with more practical information. Ha(11c)

The Welded Field Tube Boiler. (Der Geschweisste Fieldrohr-Dampfkessel.) WALTER GOLDSTEIN. *Die Schmelzschweissung*, Vol. 10, Apr. 1931, pages 92–93.

An improved construction of the suspended pipes of the Field tube boiler is described, some installations (not in Germany) are described and the welding methods applied for this particular purpose are illustrated. Ha(11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Clean Steels from the Acid Open-Hearth. C. H. Herty, Jr. (U. S. Bureau of Mines) & J. E. Jacobs (Heppenstall Co.). *Metal Progress*, Vol. 19, Feb. 1931, pages 93–99; *Blast Furnace & Steel Plant*, Vol. 19, Apr. 1931, pages 553–556; May 1931, pages 683–686.

An abstract of a paper, "Formation and Elimination of Non-Metallic Inclusions in the Acid Open-Hearth Process," read at the Western Metal Congress, San Francisco, Feb. 16, 1931. Study carried out by agreement between U. S. Bureau of Mines and Heppenstall Co. on the acid open-hearth process with 2 grades of Ni-Cr-Mo-Va steel. The factors studied were: (1) elimination of non-metallic matter in the charge and from the furnace lining, (2) oxidation of metal during the heat, (3) deoxidation with alloys, (4) elimination of silicates in the ladle, (5) segregation of non-metallics in the ingot and (6) slag reactions. The experimental work was done in 20 ton furnaces at Heppenstall with average heats of 57,000 lb. To date the first 4 items have been studied in detail. Acid practice as to charge and method of working is briefly outlined. Elimination of silicates formed by oxidation of the melt down is effected by an ore boil with an addition of spiegel to aid in fluxing the silica. Spiegel addition eliminates much greater portion of silicates than the ore boil alone. After this clean-up the bath begins to "dirty up" apparently from the furnace bottom. Grade of sand and method of making the bottom are probably connected with this condition. Manganese-silicon alloy followed by a small manganese addition eliminates inclusions from this source. The manganese-silicon alloy gives a much cleaner steel than ferrosilicon and ferromanganese. Curves show the silicates present during the working of the heat and the FeO present, determined by the aluminum method described in reference referred to. A discussion of slag conditions and composition precedes the report on use of deoxidizers. Two curves show the amount of silicates present during the addition of ferrosilicon and ferromanganese and for the manganese-silicon alloy. A curve shows the eliminations of silicates during the pouring where holding the steel as long as possible in the ladle is of direct benefit in eliminating non-metallic matter and puts the steel in better condition of temperature to cast. WLC(12a)

Study of Nonferrous Crucible Melting. Harold E. White. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Sept. 1930, pages 441–459.

A discussion on the use of nonferrous crucible melting furnace from the metallurgical, mechanical and economical point of view. CHL(12a)

Uses for the Platinum Metals. Bernard Holman. *Canadian Mining Journal*, Vol. 52, May 29, 1931, pages 556–557.

A brief discussion of the precious metals refinery of the Mond Nickel Co. at Acton. Platinum of 99.93% purity and palladium of 99.94% purity are produced. "The development of a small scale laboratory method for the recovery of palladium from jewelers' lemel and 'white gold' scrap would help extend the use of palladium." WHB(12a)

High Frequency Induction Furnace for Making Tool Steel. J. A. Succop (Heppenstall Co.). *Metal Progress*, Vol. 18, Dec. 1930, pages 40–44.

Advantages of the induction furnace for intermittent operation and for high alloy charges are described. The problem of refractories is discussed with reference to patching magnesia and the use of zirconia. Ease of temperature control and the vigorous stirring action in the bath are in favor of this furnace. The reality of claims of superiority in induction furnace steel have not been definitely proven. WLC(12a)

Constant Care Needed in Alloy Steel Manufacture. A. D. Shankland (Bethlehem Steel Corp.). *Metal Progress*, Vol. 19, Apr. 1931, pages 53–57.

The author describes the selection of raw materials, furnace and pit practice and method of control and inspection of high grade alloy steels. WLC(12a)

Fire Refining and Casting of Electrolytic Copper. L. C. Fopeano. *Engineering & Mining Journal*, Vol. 131, June 8, 1931, pages 515–517.

An attempt to suggest instruments useful in an investigation, and to outline some data on the practical operation of refining furnaces. Improper fuel control and temperature are considered the underlying causes of most refinery troubles. The various periods of the process are discussed, emphasis being given to factors effecting satisfactory control. The periods discussed include: charging, melting, skimming and blowing, poling and casting. A prolonged study of the effect of temperature on casting defects and casting efficiency showed that cracks, side splashing, porous spots, pits and imbedded mold wash increased as the cutting temperature increased. WHB(12a)

Casting & Solidification (12b)

Permanent Molds and the Influence of Cooling Rate on Gray Iron. (Ueber Dauerformen und den Einfluss der Abkühlungsgeschwindigkeit bei Grauguss.) E. Köttgen, Doktor-Ing. dissertation, Tech. Hochschule, Berlin, 1930, 14 pages, 21 figures, 22 references. Published by Giesserei Verlag, Düsseldorf.

The effects, upon a cast iron of 3.5% C, 2.5% Si, 0.4% Mn, 0.4% P, 0.1% S poured into cast iron molds, of casting size, mold thickness, mold temperature, casting temperature at constant melting temperature and variable melting temperature at constant casting temperature are given in curves, showing the resulting Brinell hardness. Electrically heated molds were used. By taking castings from the mold before they pass through the critical and then cooling at different rates, the hardness was varied from 320 to 180 Brinell. Castings frozen at such a rate that they were white on the outside were graphitized by heating 20 minutes at 900° C. A strength of 57,000 lbs./in.^{2} can be thus obtained. When the freezing rate, measured from 80° C. above the solidification point, down to the end of solidification, was over 500°/min., the structure was ledeburitic; over 300°/min., it showed eutectic graphite, over 200°/min., fine graphite, and below 200°/min., coarse graphite. By vacuum melting and by deoxidation with Al, Köttgen concludes that the effect of superheating the melt upon size of graphite flakes is connected with gas content. If the iron is oxygen and gas free (as when melted with a neutral powdered coal flame) it will have exceptional physical properties. Permanent mold castings should be cast in molds $1^1/_2$ to 2 times as thick as the part to be cast, and should be reheated to 300–400° C. The best way to control the cooling rate is to coat the mold face with an egg-shell thick refractory coating. This will last for 200–300 castings, if smoked with an acetylene flame between each cast. HWG(12b)

Casting Aluminum Pistons in Permanent Molds. G. D. Welty (Aluminum Co. of America). *Metal Progress*, Vol. 19, June 1931, pages 90–93.

Casting and heat treatment technique for aluminum alloy pistons for Diesel engines is described. WLC(12b)

Die Castings Reduce Machining. C. R. Maxon. *Machine Design*, Vol. 3, Mar. 1931, pages 42–44.

Casting with air or with mechanical external pressure or with a combination of both is best suited for rapid production of strong, sound castings. The zinc die casting alloy known as "4-3-1" is one of the most satisfactory. It has a tensile strength of 46,000 to 48,000 lbs./in.^{2} The properties of this alloy are tabulated and a number of castings, some with inserts of other materials, are described. Ha(12b)

Design of Steel Castings. C. E. Sims. *Octagon*, Vol. 35, June 1931, page 6.

Points out the importance of the use of proper design, particularly for molding, in order to get a satisfactory, sound casting. Ha(12b)

Rolling (12c)

Seamless Steel Tubing Made in Large Sizes. G. P. McNiff. *Metal Progress*, Vol. 19, May 1931, pages 39–45.

A paper read before the Western Metal Congress, Feb. 1931, San Francisco, to be published completely with discussion in the Transactions. The author describes the Mannesmann and Stiefel piercing mills. The National Tube Company's development of a double piercing method for making large sizes of seamless tube is described and discussed with reference to savings in production. WLC(12c)

The Reasons for the Dependence of the Rolling Process upon the Diameter of the Rolls. (Die Ursachen der Abhängigkeit des Walzvorganges vom Walzendurchmesser.) L. Weiss. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 47–50.

Based on experimental experiences the author claims the superiority of roller bearings in comparison with friction bearings due to a larger loss in friction of the latter. The beginning of the deformation resistance K_f beyond the static flow pressure σ is discussed and a mathematical formula derived for the evaluation of K_f. The graphical determination of the sliding distance is shown and the pressure for the remaining length of deformation computed. An approximate distribution of pressure over the whole length of deformation is deducted therefrom and the possibility of computing the distance of the resulting rolling pressure from the rolling center is outlined. The author proves that in case of $\tan \alpha \geqq \mu$, the rolling process takes place in three steps and in an irregular manner; but if $\tan \alpha < \mu$ the process takes place in two steps consistently and with very large lead. The dependence of the rolling process upon the size of the rolls is considered and the impossibility of applying large passes in case of large diameters of the rolls is discussed. In conclusion the author deals with the experimental results of Pomp and Siebel recently published. EF(12c)

Concentrated Pressure and Some of Its Applications to the Rolling Process. A. Nadai. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1057–1092.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. Several cases of elastic distribution of stress produced by concentrated loads are treated. Attempt is made to apply the information obtained by analysis to cases of similar distributions of stress produced in rolling and thus determine more exactly what goes on in severely pressed parts of rolled sheets. WLC(12c)

Recent Development of Rolling Mills for Non-Ferrous Metals. (Die neuere Entwicklung der Walzwerke für Nichteisenmetalle.) L. Weiss. *Zeitschrift für Metallkunde*, Vol. 23, Mar. 1931, pages 73–86.

The paper presented before the Deutsche Gesellschaft für Metallkunde, Berlin 1930, reviews the development of rolling mill constructions for nonferrous metals and emphasizes the multiple rolling mill system with small diameters of the rolls. Stress is laid upon the utilization of roller bearings and the various systems of multiple rolling mills are described. The phenomena occurring in the slit are discussed and attention is focussed upon the large pressures in the housing. The control of the latter is urged in order to protect the expensive roller bearings. In conclusion the speaker discusses fractures encountered in hardened supporting rolls and multiple roll housings and denies the necessity of hardening the latter. EF(12c)

Merchant Mills. U. A. Peters. *Rolling Mill Journal*, Vol. 4, Aug. 1930, pages 407–408.

Discusses briefly requirements of a merchant mill, size of billet to be rolled, power requirements and speeds. MS(12c)

Electrical Developments in the Iron and Steel Industry for 1930. D. W. Dean (Westinghouse Electric & Mfg. Co.). *Rolling Mill Journal*, Vol. 4, Dec. 1930, pages 651–656.

Discusses extensive application of electrical equipment to rolling-mill drives, their auxiliaries and related steel-mill equipment. Total horsepower applied to main drive motors for year ending Dec. 1, 1930 was 151,540, as compared with 139,350 the preceding year. MS(12c)

Remarkable Tear-Formation upon the Rolling of Noble-Metal Wires. (Merkwürdige Rissbildung beim Walzen von Edelmetall-Drähten.) L. Nowak. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 52–53.

Includes discussion. Noble-metal alloy wires were observed frequently to split lengthwise on rolling. Hard gold alloys split lengthwise but the cleavage surface was not flat but serrated and bent like the face of a cog-wheel. This is explained by a jerky application of load during over-stressing owing to an insufficient separation of rolls. Similar tears can be produced in brittle substances by pressure. RFM + EF(12c)

Motor and Control Equipment for Cold Strip Mill Drives. F. Mohler. *Iron & Steel Engineer*, Vol. 8, June 1931, pages 272–287.

The author discusses driving and control equipment in the cold rolling mill under the headings, Cold Rolling, Motors and Control. Two methods of control are discussed, giving diagrams of the electrical circuits. WLC(12c)

Forging (12d)

Quality of Drop Forgings Require Close Control. Adam M. Steever (Great Lakes Forge Co.). *Metal Progress*, Vol. 18, Nov. 1930, pages 45–49.

Closer tolerances on forgings have resulted in the hammers being more precisely made and aligned and impose greater stresses upon them than formerly. Better selection of the materials of which the hammers are made has led to less standby requirement in the hammer shop. Study of the clearances in the press and the temperature effects shows the difficulties of producing a forging 8″ × 2″ overall to a tolerance of $^1/_{64}$″. Coin pressing or cold hammer restrike methods are the only ways of producing real precision forgings. Heating furnaces with automatic temperature control assist in making good forgings. High quality of forging stock is essential. Defects from the forging practice are discussed and their remedies suggested. Quality of dies and die design are discussed. Very close control by frequent etching of the product is necessary to insure against defective forgings. WLC(12d)

Extruding (12f)

The Extrusion Process for the Production of Brass Rods, Tubes & Sections. A. Wragg. *Royal Technical College Metallurgical Club Journal*, Glasgow, No. 7, 1929–30, pages 3–8.

Very general description of the process. HWG(12f)

Heating Control in Cable Insulating. A. M. Stock. *Wire & Wire Products*, Vol. 5, Nov. 1930, pages 420–421, 443–444.

Description of insulating cables by means of lead extrusion presses. Special reference to heat control. GN(12f)

DEFECTS (13)

Occurrence of Fish-Scale in High Speed Steel. G. R. Brophy, R. H. Harrington & A. W. Merrick (Research Laboratories, General Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 440–458.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion, 3 references to the literature and macro- and micrographs illustrate the structures. Fish-scale fracture in hardened high speed tool steel is due to abnormal grain growth in the austenite. An extended study by the authors shows it to be due to thermal or mechanical strain produced while in the austenitic range. 14% W steel whether with 1 or 2% V showed this strain from air normalizing at 1560° F. or above. The 18% W steel showed fish-scale after hardening if previously air cooled from 2190° F. or above. The previous manner of working the material appears to have no influence. Deformation within the austenitic range produces similar results. Fish-scale has a bad effect upon tool performance. Drastic methods of annealing, according to the size of the piece, can be used to eradicate the condition. In discussion Sam Tour, Vice-Pres., Lucius Pitkin Co., N. Y., cites the occurrence of fish-scale in 8–10% and 5% W hotwork and die steels and relates it to the maximum and finish forging temperatures. WLC(13)

A New Forging Defect, Its Cause and Cure. W. E. Jominy & A. M. Steever. *Metal Progress*, Vol. 19, Jan. 1931, pages 94–97.

Defect is a surface hard spot showing only on individual inspection or in machining. The cause was found to be due to local carburized spots as shown in the microstructure. Most frequent occurrence of these defects found in an oil fired furnace with automatic control where for a portion of the time the oil burned with a smoky flame. Experiments checked the source of the local carburization as from coke formed by incomplete combustion of the fuel oil. Elimination of this defect lies in prevention of the formation of coke or its getting in contact with the work. WLC(13)

Why Did That Spring Break? E. E. Thum (Editor). *Metal Progress*, Vol. 19, Mar. 1931, pages 56–63.

Design, heat treatment, defects in springs, analysis and properties of spring materials are discussed. WLC(13)

Welding and Annealing. (Schweissen und Ausglühen.) W. Teuscher. *Die Schmelzschweissung*, Vol. 9, Mar. 1930, pages 62–64.

Material which is exposed, not only to compression and tension but also to impact and breaking stresses, is often found, after welding, to be of little resistance; it breaks off just at the welded seam. This was especially true with brake shoes of railroad freight cars where, frequently, welded corners broke away at the very first use despite an apparently perfect weld. Crystallographic examination revealed that, in such cases, large crystallites with the typical "hardness cracks" which only occur at sudden cooling from a temperature above 900° C. were present in the weld. In all cases, the weld showed a different structural picture from that of the material. The breaking could be avoided by a proper heat treatment after welding. The treatment consisted in annealing to at least 900°, but not exceeding 1000° C., for about 1/2 hr. The structure of both material and weld were the same. Ha(13)

CHEMICAL ANALYSIS (14)

Note on the Determination of a Very Small Quantity of Cadmium in a Rich Zinc Ore. J. G. Fairchild. *Chemist-Analyst*, Vol. 20, May 1931, pages 5–6.

After removal of the other metals of the Cu and As groups the filtrate is made not more than .3 N acid with H_2SO_4 and must be practically free from alkali salts. The cold solution is saturated with H_2S and allowed to stand 1 hour. Considerable ZnS should precipitate with the CdS. After filtering, the precipitate is dissolved in cold HCl, evaporated to dryness, dissolved in .3 N H_2SO_4 and reprecipitated with H_2S. This is again dissolved and precipitated as before to free it from Zn. The CdS is dissolved in HCl and evaporated with a drop of H_2SO_4 and weighed as $CdSO_4$. The proper acid concentration during precipitation is important. CEM(14)

Diphenylamine as an Inside Indicator for the Determination of Iron. Carroll B. Core. *Chemist-Analyst*, Vol. 20, May 1931, page 14.

Diphenylamine in a bichromate titration gives a sharp endpoint which does not fade like permanganate. H_3PO_4 is added to overcome the color of the iron salts. The solution can be back titrated with $FeSO_4$. V, Sn, Hg and Al do not interfere. $K_2Cr_2O_7$ and indicator solutions can be made up in large quantities as they do not deteriorate. Fe can be reduced by any standard method. 20 cc. H_3PO_4-H_2SO_4 and 3 drops indicator are added and the solution titrated till the green color changes to intense violet blue. Diphenylamine can also be used in a permanganate titration with the same color change. The end point does not fade even in the presence of much HCl. CEM(14)

Contribution to the Analytical Chemistry of Beryllium II. (Beiträge zur analytischen Chemie des Berylliums II.) H. Fischer & Grete Leopoldi. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 1–14.

In the first part an exact gravimetric method is described to determine Be in crude beryl and other beryllium-carrying ores and minerals and its usefulness is proved by analyses. The second part describes an analysis for determining Be in special steels containing beryllium, especially in chrome-nickel steels. All results of the analyses are given in detail. Ha(14)

Determination of Beryllium in Aluminum. H. V. Churchill, R. W. Bridges & M. F. Lee (Aluminum Research Laboratories). *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 12, Oct. 15, 1930, pages 405–407.

14 references. After a careful study of the various methods, it was found that a combination of the Havens and the 8-hydroxyquinoline methods is most satisfactory. When the separation of Al from Be becomes tedious and difficult by the Havens method, the 8-hydroxyquinoline method is most efficient. This procedure enables the analyst to evaluate his Havens separation because ignition of Al oxyquinolate precipitate reveals the amount of Al which the Havens method failed to remove. The recommended procedure is given in detail. MEH(14)

Non-Ferrous Metals and Alloys. Report of A. S. T. M. Committee B-2. W. Campbell, Chairman. *Preprint* No. 18 for June 1931 Meeting, *American Society for Testing Materials*. 12 pages.

A modification in wording of the directions for electrolytic assay of copper is recommended, and tentative methods proposed for determination of Ag, Cu, Cd and Zn in silver solders, as well as for Pb, Sn, Fe and Ni as impurities. HWG(14)

The Direct Determination of Sodium in the Presence of Aluminum and Chromium. Earle R. Caley & Darrell V. Sickman. *Journal American Chemical Society*, Vol. 52, Nov. 1930, pages 4247–4251.

It is shown that the direct magnesium uranyl acetate method for sodium is applicable in the presence of Al and Cr. The undesirability of having a high concentration of ammonium salts when making direct sodium determinations in sulphate solution is pointed out. MEH(14)

Rapid Estimation of Alloying Metals. Correspondence from C. H. Desch, Sheffield, England. *Metal Progress*, Vol. 18, Dec. 1930, pages 88–89.

The writer discusses the use of the spectroscope for analytical purposes in the study of alloys. WLC(14)

A Study of the Quantitative Precipitation of Calcium Oxalate in the Presence of the Arsenate Ion. J. T. Dobbins & W. M. Mebane. *Journal American Chemical Society*, Vol. 52, Nov. 1930, pages 4285–4288.

Calcium may be precipitated quantitatively in the presence of the arsenate ion. The solution may be made alkaline either before or after the addition of ammonium oxalate, and a small excess of ammonium hydroxide added. The best temperature for precipitation is 90–100°. MEH(14)

Spectroscopy as an Aid in Metallurgical Analyses. S. Judd Lewis. *Metallurgist*, Feb. 1931, pages 28–30.

A comparison of the analyses of iron, copper and carbon by the usual chemical analytical methods and spectroscopically showed a large number of elements undetected by chemical methods. The value of spectrographic control consists in (1) the discovery of unsuspected elements, (2) the detection and estimation of various impurities not usually comprehended in chemical analysis, (3) the examination of quantitative precipitates for their purity and (4) the correction of the gravimetric figures for the proportion of impurities carried by the precipitates. By these means much more precise assays can be obtained. VVK(14)

Cesium Sulfate as a Confirmatory Reagent in the Detection of Aluminum. Herman Yagoda & H. M. Partridge. *Journal American Chemical Society*, Vol. 52, Sept. 1930, 3579–3580.

The aluminum hydroxide, separated in the usual manner from the other III Group metals, is dissolved in 1–5 cc. of hot 3 M sulphuric acid. The resulting aluminum sulphate solution is cooled and 0.5–1 cc. of approximately 0.25 M cesium sulphate is added. On scratching the glass walls of the tube with a stirring rod, the dense white cesium alum separates and rapidly settles. MEH(14)

Titration of Lead Salts. R. C. Wiley, P. M. Ambrose & A. D. Bowers. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, pages 415–416.

The lead solution to be titrated should contain no other metals forming insoluble molybdates. It should be neutralized with ammonium hydroxide and any precipitated lead hydroxide dissolved by boiling with ammonium nitrate. The solution must be boiled until neutral and titrated with standard molybdate while hot. The end point is reached when a drop transferred to a spot plate containing the pyrogallol-chloroform indicator is colored brown. The results by this volumetric method check very closely with gravimetric results but the time required is much less by the volumetric method. MEH(14)

The Analysis of Silver-Plating Solutions. R. M. Wick. *Monthly Review American Electroplaters' Society*, Vol. 17, Dec. 1930, pages 14–19.

Methods for the determination of free cyanides, silver, carbonate, chloride and ferrocyanide are described. Ha(14)

Separation and Identification of the Alakli and Alkaline Earth Metals Using Isoamyl Alcohol. Herman Yagoda. *Journal American Chemical Society*, Vol. 52, Aug. 1930, pages 3068–3076.

A method for separating and identifying a mixture containing sodium, potassium, barium, magnesium, strontium and calcium is proposed. The essential features are: the conversion of the chlorides or nitrates to bromides with 8 *N* hydrobromic acid; separation of Na, K and Ba bromides from Mg, Sr and Ca bromides using isoamyl alcohol; separation of Na and Ba bromides from KBr using ethyl alcohol; precipitation of Na and Ba chlorides with 12 *N* HCl from the ethyl alcohol solution; separation of Mg from Ca and Sr by ignition of the nitrates; separation of Sr from Ca by dissolving Ca nitrate in 16 *N* HNO_3. MEH(14)

Determination of Cadmium Lead and Iron in High-Grade Zinc. B. H. Strom. *Engineering & Mining Journal*, Vol. 131, May 25, 1931, pages 465–466.

The methods employed in the laboratory of the Anaconda Copper Mining Co. are capable of determining such impurities as Cd, Pb and Fe in quantities of 0.001 per cent Pb and Cd are usually determined on the same sample. 100 g. of shot or drillings, in a two-liter beaker are moistened with 100 cc. of water and dissolved by 350–400 cc. of nitric acid. The cooled solution is treated with ammonia, with constant stirring till zinc hydroxide is dissolved, and 200 cc. excess added. Yellow ammonium sulphide (1:10) is added cautiously to precipitate Cd, Pb and a little Zn. Pb is determined as sulphate and Cd separated from the small amounts of Zn by precipitation with hydrogen sulphide in the filtrate from the Pb in hot solution. For Pb only: to a 100 g. sample is added 1 g. ferric sulphate and nitric acid, and the Fe precipitated with ammonia. This Fe precipitate is redissolved with hydrochloric acid (1:1) and fumed with 15 cc. sulphuric acid (1:1) and weighed, or titrated. Pb may be determined electrolytically in Zn, Cu or Cd by taking 86 g. of sample, dissolving in 320 cc. nitric acid and 100 cc. water, adding 2 g. calcium carbonate, diluting to 800 cc. with hot water and making strongly alkaline. Bring to boiling and precipitate with ammonium carbonate. Filter by decantation, washing the precipitate into a 250-cc. beaker, and dissolve the remainder on the paper with 3 cc. nitric acid, diluted with 20 cc. water. A few drops of silver nitrate solution and 1 cc. of strong copper nitrate solution are added, 200 cc. water added and the solution electrolyzed with .5–1.0 amp. with platinum electrodes. Fe is determined colorimetrically. WHB(14)

Determination of Antimony in Lead-Antimony Alloys of Low Antimony Content. Leon I. Shaw, Charles F. Whittemore & Thor H. Westby. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, pages 402–403.

Five references. Presented before Division of Physical and Inorganic Chemistry at the Atlanta, Ga., Meeting of the American Chemical Society, April 1930. Data are given by way of comparison of the three permanganate and two bromate methods, for the determination of Sb in two Pb-Sb alloys containing about 1% Sb. The method described here is a modification of the permanganate method, and eliminates the use of copper sulphate and uses concentrated sulphuric and fused bisulphate at 320° C. for dissolving sample. Heating is continued for 20–30 minutes, solution is cooled, diluted, HCl added, again heated to boiling for 15 seconds, cooled, diluted and titrated at 10–12° with permanganate. The method is claimed to be rapid and accurate for routine procedures. MEH(14)

Rapid Estimation of Carbon in Refining Stage. Correspondence from Einar Oehman, Stockholm, Sweden. *Metal Progress*, Vol. 19, Apr. 1931, pages 90–91.

The writer describes the "carbometer" invented 18 years ago and tried successfully for the rapid determination of carbon on the open hearth floor, by a magnetic method. On 271 heats aiming for a range of .60–.65% carbon with the aid of this instrument 93% of the heats came within the range, 5.5% .01% carbon high or low, and 1.5% of the heats .02% carbon high or low. WLC(14)

Rapid Method for Determining Calcium in Lead Alloys of Low Calcium Content. Leon I. Shaw, Charles F. Whittemore & Thor H. Westby., *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, pages 401–402.

Presented before the Division of Physical and Inorganic Chemistry at the Atlanta, Ga., meeting of the American Chemical Society, April 1930. By this method it is possible to complete a single determination in 25 minutes by uninterrupted attention of the analyst. Duplicates can be run in 45 minutes. Data are given showing comparison of results of determinations of calcium in a low-calcium alloy by the 18-hour method and the rapid method. MEH(14)

HISTORICAL & BIOGRAPHICAL (15)

Progress in the Manufacture of Rustless Steels. J. H. MONYPENNY. *Foundry Trade Journal*, Vol. 43, Aug. 7, 1930, page 98.

Abstract of a paper presented to the Liege Mining & Metallurgical Congress. Chrome and chrome-nickel steels were the first kinds used for resisting corrosion. Gives an account of progress achieved and difficulties that have been overcome in producing these steels. VSP(15)

International Nickel. (The Story of the Men Who Built Up This Huge Industry.) A. J. WADHAMS. *Canadian Mining Journal*, Vol. 51, Aug. 29, 1930, pages 838–841.

Historical sketch. WHB(15)

ECONOMIC (16)

Engineering Markets of the World. VII. A. J. LIVERSEDGE. *Engineering*, Vol. 130, Dec. 12, 1930, pages 732–735; Dec. 19, 1930, pages 780–782.

Deals with the situation in the United States. Gives tables and curves showing import figures of U. S. for 1925–1928 and 1913 for comparison. The market in U. S. for engineering products is small because it is largely supplied from home sources. Imports amounted to only 4.3% of total amount consumed. In 1913, United Kingdom was first in supplying iron and steel to U. S. In 1926, Germany was in first place and has held it ever since. Belgium is now in second place and United Kingdom in third place. Table is given showing types of iron and steel imports into the U. S. in 1928. In all classes of engineering products, figures show that the United Kingdom is gradually losing its hold in the American market. Discusses trade situation in Latin American countries. These countries manufacture no iron and steel on a commercial scale and very few other products so there is an immense market for engineering products. Figures are given showing United Kingdom and U. S. engineering exports to Latin America for 1913, 1927 and 1928. In iron and steel, figures show that the United Kingdom is beaten by U. S. by only a small margin. For machinery and electrical apparatus, United Kingdom figures are very low compared to those of U. S. LFM(16)

Manganese and Manganiferous Ores in 1929. LEWIS A. SMITH. *Mineral Resources of the United States*, 1929, Part 1, pages 275–332, *United States Bureau of Mines*, May 19, 1931.

Domestic mines in 1929 shipped 60,379 long tons of high-grade manganese ore, as compared with 46,860 tons in 1928. Shipments of ferruginous manganese ore and manganiferous iron ore amounted to 1,188,258 long tons, a slight increase. Production of spiegeleisen increased from 99,517 tons in 1928 to 137,143 tons in 1929. Imports of manganese ore amounted to 664,266 long tons, an increase of 236,561 tons over 1928. Ferromanganese production at domestic furnaces amounted to 339,205 long tons in 1929. Contains 78 footnote references. AHE(16)

Simplified Account for Welding Shops. WM. T. WHEELING. *Welding*, Vol. 1, Sept. 1930, pages 748–753.

A detailed description of 17 forms and the manner in which they can be adopted successfully for keeping accurate records of a job shop. Ha(16)

Gold and Silver as Monetary Metal. CARL SNYDER. *Mining & Metallurgical Society of America Bulletin*, Vol. 24, No. 219, Apr.-May 1931, pages 49–67.

Paper with discussion. A brief history of the use and value of the 2 metals and a fuller treatment of their influence on modern national economics. The production of gold and silver is greatest in modern days, growing at an almost steady rate just as other commodities, although to an even greater degree. It is stated that the amount of monetary gold had no influence on the economic structure of the world but that the influence was rather one of distribution. Ratio of gold to silver value, propositions to demonetize either material are dealt with and it is shown that the seemingly singular paradox of enormous change in value of money metals had relatively little influence on the price level of commodities which is mostly due to the great inertia in modern industry and an enormous degree of necessary adjustment. In the discussion, more specific conditions are discussed. Ha(16)

Aluminium in 1930. *Metal Industry*, London, Vol. 38, Apr. 17, 1931, page 408.

U. S. production of new aluminum was 102,248 tons valued at $50,961,000. Strong aluminum alloys, electrical conductors and paint saw an increase in consumption of aluminum. A new piston alloy of low expansion coefficient was introduced. The use as roofing and as an exterior ornamental metal is increasing. PRK(16)

The Tin Situation. *Metal Industry*, London, Vol. 38, Mar. 13, 1931, pages 299–300.

Dutch and British producers of tin are coöperating in controlling production which is fixed on a basis of a world production of 126,000 tons. PRK(16)

Copper in Belgian Congo. *Metal Industry*, London, Vol. 37, Aug. 22, 1930, pages 169–172, 197–200.

Description of some of the interests of the Union Minière du Haut Katanga. Taken from a brochure published by the company, entitled "Katanga, the Country of Copper." First metallurgical operations date from 1911. In 1912, production was 2500 tons. Cu deposits are classified in 3 main groups: those of the east, the center and the west. Ore deposits prospected up to Jan. 1929, were estimated at 75 million tons, containing from 3 to 25% Cu. Cu ores are mined at Kambove, Prince Leopold, Luishia, Ruashi, Lukuni, Likasi and Chituru. Ores containing from 6 to 10% Cu are concentrated in three sections: grinding and screening; mechanical concentration; and concentration by flotation. Total output contains on an average 40% of fines and are treated in reverberatory furnaces. Ores in which Cu is widely distributed are treated by leaching, followed by electrolysis. At Antwerp, a large refinery treats crude Cu obtained from Katanga. Two grades are made, containing 99.8 and 99.95% Cu, respectively. The plant has a capacity of 80,000 tons of pure Cu per annum. VSP(16)

Statistic Tables on Aluminum. (Statistische Zusammenstellungen über Aluminium.) *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 2, Sept.-Oct. 1930, pages 159–167.

Comparative tabulation of world production of non-ferrous metals (Al, Pb, Cu, Zn, Sn) from 1909 to 1929, price fluctuations, import duties of different countries, consumption, production of bauxite, import and export. Ha(16)

American Machinist 1930 Inventory of Metal-Working Equipment. *American Machinist*, Vol. 73, Sept. 18, 1930, page 471.

Inventory and classification of various types of furnace equipment in industrial plants. Compares 1920 and 1929. 32% of the equipment is over 10 yrs. old. RHP(16)

Some Aspects of the Iron Ore Situation. F. B. RICHARDS (Hanna Furnace Company). *Rolling Mill Journal*, Vol. 4, Nov. 1930, page 600.

From paper read before the American Institute of Mining & Metallurgical Engineers, Sept. 22–26, 1930. MS(16)

PLANTS & LABORATORIES (17)

Bethlehem's Heat Treatment Shop. S. D. GLADDING (Bethlehem Steel Corp.). *Metal Progress*, Vol. 18, Dec. 1930, pages 74–80.

The author describes the electric handling and heat treatment equipment in this shop. Photographs illustrate details of layout described. WLC(17)

Electrochemical and Electrometallurgical Institute at Grenoble. (L'-institut d'electrochemie d'electrometallurgie de Grenoble.) R. SEVIN. *Journal du Four Electrique*, Vol. 40, Feb. 1931, pages 45–48.

The sketch of the circumstances leading to the establishment of this institution. JDG(17)

Answering a New Demand. J. B. HAMMOND. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 67–69.

The Illinois Steel Co. has built a new 10-in. mill especially for rolling small sections of alloy steel. Ha(17)

The Research Laboratories of the Metallgesellschaft. H. VON HALBAN. *Metallgesellschaft*, Vol. 4, Aug. 1930, pages 3–16.

A detailed description and illustrations of the laboratories of the company in Frankfort a. M. They comprise the analytical chemical laboratory, including ore-dressing shops, the metal laboratory, the technico-chemical laboratory, the physico-chemical laboratory and the colloid-chemical laboratory. Buildings, installation, materials used, equipment, lighting system are described in detail. Ha(17)

Research Institutes for Pure and Applied Chemistry in the United States of America. (Forschungs-Institutionen für reine und angewandte Chemie in den Vereinigten Staaten von Nordamerika.) K. G. STERN. *Zeitschrift für angewandte Chemie*, Vol. 44, Apr. 11, 1931, pages 270–273.

The writer divides the various research institutes into 3 different groups: first, technical societies; second, independent organizations; and, third, industrial organizations. This article covers a relatively small number of those institutions that have been founded for pure and applied research in the United States. It is illustrated by a picture of the projected Mellon Institute building. OWE(17)

The Foundries of the Daimler Company. *Foundry Trade Journal*, Vol. 44, June 25, 1931, pages 433–435, 438.

An article illustrated by 9 photographs and 1 diagram, describing the foundries of the Daimler Company, in which space is devoted to the manufacture, in large and small quantities, of iron, steel, non-ferrous and light alloy castings. OWE(17)

The Foundry of the Midland Electric Manufacturing Company, Limited, An Outstanding Example of Mechanisation. *Foundry Trade Journal*, Vol. 44, June 4, 1931, pages 383–384.

A description of a foundry devoted to the quantity production of electrical switch and fuse gear, in which conveyor systems, etc., have been utilized to assist in production. Illustrated by 3 photographs and 1 diagram. OWE(17)

The Longbridge Works of the Austin Motor Company, Ltd. *Metal Industry*, London, Vol. 38, June 5, 1931, pages 573–574.

Except for certain equipment the whole of the components in an Austin car are manufactured at the factory which uses 120,000 tons of raw material and 50,000 tons of fuel annually. The steel section of the foundry is equipped with 3 Stocks oil fired converters. PRK(17)

Many Sizes and Parts Heat Treated by Brown and Sharpe. E. W. FREEMAN (Brown & Sharpe). *Metal Progress*, Vol. 19, Jan. 1931, pages 61–65.

Very diverse production makes the number and character of furnaces in the Brown and Sharpe hardening establishment large and wide. Photographs show sections of the layout and the author describes the installations of carburizing and annealing, pot type furnaces, small oven furnaces, tempering and high speed steel furnaces. The pyrometric control is described. Need for skilled and intelligent workmen to handle properly this modern equipment is emphasized. WLC(17)

The Foundries of Messrs. Crane-Bennett, Limited. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, pages 239–241.

A description of foundries making black heart castings for malleable pipe fittings and gray iron castings for radiators and boilers for central heating. The article is accompanied by 4 diagrams. OWE(17)

An Electrified Steel Mill. R. H. WRIGHT. *Electric Journal*, Vol. 28, Mar. 1931, pages 146–151.

1930 improvements in the Alabama City plant of the Gulf States Steel Co. include: the replacement of the one existing engine-driven mill with a new larger motor-driven mill and the installation of a 48-inch 3-high universal plate mill, a sheet mill and an increase in substation capacity of 10,000 kvs. Features of each unit are pointed out. WHB(17)

Finishing Industrial and Scientific Meter Parts. THOMAS H. WITTKORN. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 785–788.

Describes cleaning, enameling, and plating procedures followed by the Brown Instrument Co., Philadelphia, Pa. MS(17)

A Carburizing Plant Under Scientific Control. R. G. GUTHRIE & J. A. COMSTOCK. *Metal Progress*, Vol. 19, Apr. 1931, pages 75–80.

The authors outline the functions of a metallurgical control laboratory in the plant of a user of steel. The various laboratory tools are enumerated and their applications to control described. One of the functions of the metallurgist is illustrated in the plan worked out for a new heat treating operation. The metallurgist prepared the layout, specified the furnaces and accessory equipment for the most modern carburizing work. This plant is described in detail. WLC(17)

The Bayonne Foundry. E. S. WHEELER (International Nickel Co.). *Engineering & Mining Journal*, Vol. 130, Nov. 10, 1931, page 488.

A brief description of the Bayonne, N. J., plant of the International Nickel Co. where nickel, Monel metal, everbrite and nickel-resist are cast. WHB(17)

Building for the Needs of Tomorrow. G. G. THORP. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 22–23.

The new 28-inch Strip Mill at Gary, Illinois, in the Illinois Steel Co., has a capacity of 25,000 t./mo. of strip up to 26 in. wide. It is semi-continuous. Ha(17)

Electric Heat Treating Setup Insures Uniformity and Cleanliness. S. D. GLADDING (Bethlehem Steel Co.). *Steel*, Vol. 87, Nov. 27, 1930, pages 43–47.

Description of the plant of the Bethlehem Steel Co., at Bethlehem, Pa., for the normalizing, annealing, quenching and tempering of alloy and C steel bars in sections of 0.25–8 in. and in lengths up to 25 ft. A roller-hearth furnace is used for normalizing or heating for quenching. It consists of a preheating chamber operating at 800° F. and a high temperature chamber. There are 2 pit annealing furnaces, which are divided into 6 zones—3 lengthwise and 2 high. Next in line are 2 car-bottom furnaces, consisting of 2 chambers built in one shell with a common center wall. MS(17)

German Steelmaker Adds to Production Facilities. HUBERT HERMANNS. *Steel*, Vol. 87, Oct. 16, 1930, pages 66, 68.

Describes extensions to the plant of the Mannesmannröhren-Werke at Huckingen, Germany. MS(17)

Stamping and Forging Special Steels. A. H. ALLEN. *Steel*, Vol. 87, July 31, 1930, pages 43–46, 53.
Describes work of the Transue & Williams Steel Forging Corp., Alliance, Ohio, on the development and production of stampings and forgings from Nitralloy and Nirosta KA2. MS(17)

Mass Production of Disk and Wire Type Auto Wheels. A. H. ALLEN. *Steel*, Vol. 87, Sept. 18, 1930, pages 47–50, 52.
Describes equipment and operations of the Budd Wheel Co. MS(17)

Effects Economies in Small Stampings Production. A. H. ALLEN. *Steel*, Vol. 87, Oct. 2, 1930, pages 60, 62, 64.
Describes plant and practice of the Detroit Stamping Co., Detroit, Mich. MS(17)

Heat Treating Pipe Line Couplings. C. B. PHILLIPS (Surface Combustion Co.). *Steel*, Vol. 87, Dec. 25, 1930, pages 43–45.
Describes equipment and practice of the S. R. Dresser Mfg. Co., Bradford, Pa., with special reference to the installation of continuous gas-fired forging and reheating furnaces. MS(17)

Case-Hardened Steel Parts Resist Severe Wear and Shock. J. B. NEALEY. *Steel*, Vol. 87, Sept. 4, 1930, pages 43–45.
Describes equipment and practice of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, which has developed a special method for carburizing steel parts to depths of $^3/_{16}$–$^1/_4$ in. A carburizing compound developed in its laboratories is used. It is claimed that a uniform hardness is obtained throughout the depth of the case. Most of the work is made from a 0.20% C steel. After carburizing, the C content of the surface is 0.90–1.20% and the scleroscope hardness ranges from 90 to 100. Use 16 large furnaces for carburizing and subsequent heat treatment. MS(17)

The Evans-Wallower Electrolytic Zinc Plant. FOSTER S. NAETHING (Evans-Wallower Zinc Co.). *American Metal Market*, Vol. 38, Apr. 22, 1931, pages 5, 7.
Presented at Annual Convention American Zinc Institute, April 1931. Summary of Tainton high-acid, high-current density process electrolytic Zn plant at Monsanto, East St. Louis, Ill. Details of roasting, leaching, filtering, electrolytic cell room, melting and by products, market for 99.99% Zn. DTR(17)

Buildings for Metalware Pickling and Hot Galvanizing. WALLACE G. IMHOFF. *American Metal Market*, Vol. 38, Apr. 16, 1931, pages 5, 10.
General discussion of relation between floor space, size, shape and building construction materials, drainage facilities, sanitation, lighting, etc., with respect to technique of pickling and hot galvanizing operations. Establishes good practice. DTR(17)

Core-Drying Ovens for Continuous Operation. (Kerntrockenöfen mit durch laufendem Betrieb:) H. ILLIES. *Die Giesserei*, Vol. 17, Aug. 22, 1930, pages 825–826.
Describes an arrangement of the American Radiator Co. in Buffalo and shows the advantages. An oven is described. Ha(17)

Zinc Smelting in Mexico. W. J. JENNI & R. F. SPOONER (American Smelting & Refining Co.). *American Metal Market*, Vol. 38, Apr. 28, 1931, pages 3, 10.
Paper presented at Annual Convention, American Zinc Inst., St. Louis, Mo., April 1931. Complete plant description of sole Zn smelter in Mexico, at Rosita, State of Coahuila. Details of fuel; power; concentrate sampling and handling; roasting with four 20-foot, 12-hearth Skinner roasters; 4-unit 3-section plate type Cottrell treater; Dwight-Lloyd sintering machine, pallet width 63 in., length of wind box 60 feet, with Sintering Machine Corporation suction fan of 75,000 cu. ft. per minute capacity; coke crushing and mix room; retorts and retort furnaces; refinery of 2 reverberatory type liquating furnaces 6 ft. by 24 ft. inside and $3^1/_2$ feet depth of bath; acid plant and condenser concentrator. DTR(17)

MACHINERY & SUPPLIES (18)

Roller Bearings in Swedish Mills. Correspondence from A. WESTGREN (Stockholm). *Metal Progress*, Vol. 18, Dec. 1930, pages 85–86.
The writer describes developments by SKF of the use of roller bearings. WLC(18)

Individual Drives for Table Rolls. W. B. SNYDER (General Electric Co.). *Iron & Steel Engineer*, Vol. 8, Mar. 1931, pages 93–95.
Description of motors and control equipment. WLC(18)

BIBLIOGRAPHIES (19)

Contributions to the Chemistry of Iron, July-September 1930. (Beiträge zur Eisenhüttenchemie, Juli–September 1930.) A. STADELER. *Stahl und Eisen*, Vol. 51, Jan. 15, 1931, pages 71–76.
The author reviews 31 publications referring to steel mill chemistry. GN(19)

Bibliography of the Metallurgical Work of the U. S. Bureau of Mines in 1930. R. S. DEAN. *Bureau of Mines Information Circular* 6449, April 1931, 7 pages.
Over 60 references are given to articles on fundamentals, ore dressing, iron and steel, hydrometallurgy, manganese investigations, rare and precious metals, non-ferrous metals, laboratory apparatus and methods and discussions. AHE(19)

Bibliography of Aeronautics, 1929. National Advisory Committee for Aeronautics. United States Government Printing Office, Washington, D. C., 1930. Cloth, 242 pages. Price 50 cents.
This bibliography of aeronautics for 1929 covers aeronautic literature published from Jan. 1 to Dec. 31, 1929. Citations of the publications of all nations are included in the languages in which these publications originally appeared. The arrangement is in dictionary form, with author and subject entry, and one alphabetical arrangement.
It may be obtained directly from the Superintendent of Documents, Government Printing Office, Washington, D. C.—(19)-B-

Supplement to a Bibliography on Effect of Temperature on Properties of Metals. *Research Publication American Society Mechanical Engineers*, 1931, 26 pages.
This supplement is a continuation of the bibliography prepared by the A. S. M. E.-A. S. T. M. Joint Research Committee on Effect of Temperature on the Properties of Metals published in 1928. The references are arranged chronologically, beginning with 1927 (reference 308) and ending with 1930 (reference 562). Fifty-two references on the Oxidation of Metals at High Temperature are arranged chronologically from 1916 to 1930. RR(19)

A Bibliography on the Cutting of Metals. *Research Publication American Society Mechanical Engineers*, 1930, 63 pages.
Lists 778 references beginning with 1866 and ending with 1930. No attempt is made at correlating or drawing conclusions, but rather the references with a few words of explanation, are arranged chronologically. RR(19)

MISCELLANEOUS (20)

The Question of Safety in Designing. (Zur Frage der Sicherheit in der Konstruktionslehre.) A. THUM. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, June 6, 1931, pages 705–708.
The manner in which strength in structures and machinery is commonly calculated is not suited to modern requirements; it should be modified to allow a consideration of dynamic conditions to the widest extent. The defects of old methods are discussed and directions given for taking account of inadmissable deformations, forcible fractures by impacts and influence of notch effects. Ha(20)

Prevention of Acetylene Explosions and Extinguishing of Acetylene Fires (Verhütung von Azetylenexplosionen und Ablöschen von Azetylenbränden.) A. P. BOTTKE. *Autogene Metallbearbeitung*, Vol. 23, May 15, 1930, pages 157–163.
Acetylene plants should, from the beginning, be laid out and built so that if fire should break out the personnel can get out in the shortest possible time. Fire proof doors between rooms must be provided. Compressed nitrogen and carbonic acid snow have proved to be most effective for extinguishing fires. Sand is of little use; water only if it is possible to get close to the seat of the fire. Water is, however, very useful in cooling the plant by means of sprayers. Ha(20)

Fume Recovery from Electric Furnaces. E. H. DECONINGH (Dust Recovering and Conveying Co.). *Metal Industry*, N. Y., Vol. 29, May 1931, page 221.
The fumes from 3 Detroit electric furnaces of 1 ton capacity, melting a copper-tin-zinc-lead alloy, are recovered by means of a 6 compartment Dracco filter using cloth tubes. Efficiency is 99% and up to 2000 lbs. per day of material containing 70% Zn is recovered. PRK(20)

The Effective Fighting of Acetylene Fires. (Die zweckmässige Bekämpfung von Azetylenbränden.) CARL TIMM. *Die Schmelzschweissung*, Vol. 9, Mar. 1930, pages 56–57.
The origin and causes of acetylene ignition are discussed. Nitrogen and carbon dioxide snow have been found to be the most effective extinguishers. Carbon tetrachloride, on the contrary, should be strictly avoided because of the danger of phosgene gas being formed in the heat of the acetylene flame. Ha(20)

Lead Base Lubricants and Their Use. JAMES EDWARDS. *S. A. E. Journal*, Vol. 28, Jan. 1931, pages 50–52.
The increased gear-tooth pressure required a lubricant that forms an oil film able to withstand this higher pressure. Such film can be provided by a lead-soap-base lubricant composed of lead-soap intimately mixed with hydrocarbon oil. The properties and analyses of 3 different kinds are given. Ha(20)

Use of High Frequency Oscillation in Metallurgy. (L'utilisation des oscillations de haute frequence en Metallurgie.) M. FAYOLLET. *Aciers Speciaux Métaux et Alliages*, Vol. 6, Jan. 1931, pages 11–15.
A critical review of G. Mahoux' discovery of using high frequency current in increasing the depth of nitriding, chromium plating and decarburization. GTM(20)

Directions for the Construction of Correct Water Protectors for Acetylene High-Pressure Apparatus. (Richtlinien für den Bau geeigneter Wasservorlagen für Azetylen-Hochdruckapparate.) H. FRIEDRICH. *Autogene Metallbearbeitung*, Vol. 24, Apr. 15, 1931, pages 111–119; May 1, 1931, pages 127–134.
From the Chemisch-Technische Reichsanstalt, Berlin. All acetylene apparatus must be equipped with arrangements which offer safety against back firing and prevent the danger of oxygen entering into the acetylene containers. Such arrangements usually consist of water-filled chambers in the path of the acetylene. The testing arrangement for ascertaining this safety and the apparatus used in the test are described and the results critically discussed with regard to dependence on water pressure, section and dimension of the water chamber, protection against backfiring (in which case the explosion gases must be conducted into the air immediately) and the arrangement of locating water chambers before every branch of the acetylene container. Ha(20)

Measuring Results of Invar-Wires. (Messungsergebnisse an Invardrähten.) LAMPE NEUMANN & WEBER. *Zeitschrift Vermessungswesen*, Vol. 60, June 1, 1931, pages 315–322.
Several wires of Invar were measured by the National Institutes of Germany, Great Britain and France. The methods are described and the changes in length tabulated. Ha(20)

Brass Fever and Its Prevention. (Das Messingfieber und seine Verhütung.) M. GRUENWALD & E. KALISCH. *Die Schmelzschweissung*, Vol. 9, Apr. 1930, pages 89–90.
Due to the great difference of melting points of the constituents of brass (copper at 1084° C. and zinc at 419° C. with a boiling point at 925° C.), the zinc in the alloy will already have begun to evaporate when brass melts and will burn to zinc oxide which forms a fume and is condensed again as a white deposit in the vicinity. This zinc oxide is injurious to the lungs and respiratory organs and causes fever to those inhaling the vapor. The symptoms are described and, as remedy, hot milk and tea of a certain herb are recommended. Melting of brass should, therefore, be done only in large shops and the vapors exhausted before the melter can inhale them. Ha(20)

Structures, Strength, Continuity. (Struktur, Festigkeit, Stetigkeit.) W. KUNTZE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 7, 1931, pages 285–288; *Mitteilungen deutscher Materialprüfungsaristalten*, Souderheft, XVII, 1931, pages 48–52.
The knowledge of the relation between the inner structure and strength of a material forms the basis for the designing engineer. To a greater extent than is usual at present, the proper conception of strength and its technical determinations should be developed according to structural, rather than according to technological, points of view. It is shown that a conception of strength which is closely related to the structure of the material can offer to the designing engineer a natural and precise means of solving questions of safety and can elucidate many doubts and discontinuities in the stresses and strength of a given piece. A few examples of cohesion, vibration, strength, overload stresses, discontinuities due to changes of section illustrate the views of the author. Ha(20)

Problem of Torsional Vibration Increases with Engine Power. J. ORMONDROYD. *Machine Design*, Vol. 3, June 1931, pages 37–40.
The danger of torsional critical speeds, particularly in modern machines where the ratio of weight to power is made smaller and smaller, is pointed out and explained. The speeds can be calculated exactly and even avoided by proper design. The basic theoretical considerations are explained and illustrated by the example of a Diesel engine. Ha(20)

The Temperature and Velocity Field of a Vertical Plate Giving Off Heat at Natural Convection. (Das Temperatur- und Geschwindigkeitsfeld vor einer wärmeabgebenden senkrechten Platte bei natürlicher Konvektion.) ERNS SCHMIDT & W. BECKMANN. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Feb. 21, 1931, page 227.
Description of tests from which a simple formula for the heat convection from a heated plate to the surrounding air and the buoyancy of the plate in the air can be calculated. Ha(20)

Regulations for Installation and Operation of Factories for the Production of Dissolved Acetylene. (Richtlinien für die Errichtung und den Betrieb von Fabriken zur Herstellung von gelöstem Azetylen.) *Autogene Metallbearbeitung*, Vol. 24, May 15, 1931, pages 152–153.

These German regulations refer to location of factories, buildings and equipment, fire extinguishers and protection for the particular safety of the high-pressure part of the factory. Ha(20)

Proper Lubrication Insures Longer Bearing Life. H. S. TRECARTIN. *Houghton's Black & White*, Vol. 3, May 1931, pages 13–17.

The oil used should be selected for proper weight or thickness, lubricity, purity and freedom from sulphur or acids. It must be clean so that it carries no dirt to the bearing. It should be drained and washed periodically. Ha(20)

Handling Assembly and Tests from an Overhead Monorail System. C. W. PRESTON (Majestic Household Utilities Corp.). *Iron Age*, Vol. 127, April 2, 1931, pages 1084–1088.

From a paper read before the National Industrial Congress, through the auspices of the American Society of Mechanical Engineers. Describes details of operation in handling of materials through the plant of the Majestic Household Utilities Corporation. Cost of operation is lower for the area covered than other systems appeared to offer. VSP(20)

The Manufacture of Slag Brick. R. BELL. *Engineering Progress*, Vol. 11, Nov. 1930, pages 293–294.

Slag from the blast furnace is cooled rapidly as it runs from the furnace. This results in the formation of small glass-like grains. These may then be converted to brick by the steam hardening process which is described. RHP(20)

On the Attack of Metals by Insects. (Ueber den Angriff von Metallen durch Insekten.) O. BAUER & O. VOLLENBRUCK (Kaiser Wilhelm Institut für Metallforschung). *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, page 117.

The attack of Zn by an insect is discussed. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 46. EF(20)

Metal-Destroying Insects. W. MICHAELIS. *Engineering Progress*, Vol. 11, Oct. 1930, page 260.

Abstract of an article by Bauer and Vollenbruck in *Zeitschrift für Metallkunde*, July 1930. Two species of beetle, the Dermestes Peruvianus and the Dermestes lardarius were found to work on lead and tin foil. They did not attack Al, Zn or brass. They usually damage lead pipes. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 46. RHP(20)

New Applications of Ammonia. M. H. MERRISS (DuPont Ammonia Corp.). *Compressed Gas Manufacturers' Association 18th Annual Report*, 1930, pages 28–37.

At present about 72.5% of the synthetic nitrogen of the U. S. A. is employed in agriculture. For other purposes the percentages are: 17% explosives, 12% refrigeration, 20% miscellaneous, and 51% chemicals and acids. Ammonia is revealed as a many-sided chemical. Its uses are: as an alkali, a fuel, a reducing agent, a source of an acid, a fertilizer material and a means of purifying drinking water. The ammonia-chlorine treatment of water is applied in six ways and the source of hydrogen and nitrogen for fourteen different operations among which are welding, cutting, hydrogenation, lighter-than-air craft, brazing, sulphur removal from coke, inert atmosphere for chemical reactions, etc. A bibliography is included. WHB(20)

Radiation from Metals Bombarded by Low-Speed Electrons. F. L. MOHLER & C. BOECKNER. *Bureau of Standards Journal of Research*, Vol. 6, Apr. 1931, pages 673–681.

A small probe surface at a positive potential in a discharge may draw a current of many amperes/cm.^{2} with the potential gradient limited to a thin sheath over the surface. Under such conditions a continuous spectrum is emitted by metal surfaces in Cs, K, and He discharges. With a Cu probe at 7 volts in Cs vapor, the intensity J (λ) remains of the same magnitude between 6200 and 2400 A with a minimum at 5800 and a maximum at 3800. Below 4 volts the spectrum has a high-frequency limit in this range (3000 A for copper at 2.15 volts). On the assumption that this is analogous to a continuous X-ray spectrum, observed limits indicate work functions of 1.95 volts for Cu, 2.1 for Ag, 1.45 for W (all in caesium vapor). The absolute intensity (except for Ag) agrees within a factor of 2 with values computed from the theoretical equation for intensity of the continuous X-ray spectrum. Efficiency for Cu at 7 volts is estimated as 5×10^{-7}. Comparison with published data on photo-electric effect of radiation from electron bombardment of metals indicates that the magnitude of effects below 10 volts can be explained by this continuous spectrum. (20)

Some Notes on Cast Iron Plating Tools. ROGER POWELL. *Iron & Steel Industry & British Foundryman*, Vol. 4, Feb. 1931, pages 161–162.

From service records the essential of a good plating tool appears to be a good chill 1½ to 3 inches deep. CHL(20)

Detonation Temperatures of Acetylene. (Verpuffungstemperaturen des Azetylens.) W. RIMARSKI & M. KONSCHACK. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 5, 1930, pages 100–103.

Several accidents by spontaneous disintegration of acetylene in closed containers under explosion-like phenomena were the cause of an investigation. Experience had shown previously that acetylene in the presence of an iron surface heated to 510° C. explodes at a minimum pressure of 3.05 atmospheres and a flow of 0.4 l./min. The tests showed that the same phenomenon occurred with other materials than iron at considerably lower temperatures. Oxides (rust), in particular, reduce this temperature to as low as 250° C. A table of 31 different materials shows the explosion temperatures. These tests are being continued. Ha(20)

Electrolysis Tests Quickly and Accurately Made. A. V. SMITH. *U. G. I Circle*, Dec. 1930, pages 4–7.

Buried iron pipes and lead cable sheaths are the conductors dealt with in this article, which describes in particular a special truck equipped for the testing of underground metallic structures. Truck designed by Albert F. Ganz, Inc. Equipment and method of its use are described. MFB(20)

Detinning of Scrap Tin Plate. WILFRED W. SCOTT & NELE E. DAVIS. *Industrial & Engineering Chemistry*, Vol. 22, Aug. 1930, pages 910–911.

The recovery of tin from old tin cans and tin-plate material in general is accomplished on a small scale by subjecting the scrap to alternate action of 5% tartaric acid solution and air in a rotating steel drum. The tin tartrate is treated with hydrogen sulphide, regenerating the acid. The detinned scrap contains about 0.1% Sn which is low enough to permit its use in steel manufacture. MEH(20)

Application of Microscopy to an Unusual Manganese Ore-Dressing Problem. *American Metal Market*, Vol. 38, Feb. 5, 1931, page 13.

A microscopic study of a low-grade manganese ore has been completed at the Intermountain Experiment Station of the U. S. Bureau of Mines, Salt Lake City, Utah, in coöperation with the University of Utah. It showed that the manganese was chemically combined with siderite (iron carbonate) and it is therefore impossible to effect a separation of manganese and iron through grinding, followed by flotation or other mechanical method of concentration. A preliminary microscopic examination is not only the quickest and most direct way of reaching the heart of an ore-dressing problem but is frequently the only reliable method available for accurately diagnosing ore-dressing ills. WHB(20)

FOUNDRY PRACTICE & APPLIANCES (22)

Proceedings of the International Foundry Congress at Liege on June, 23-28, 1930. (Compte Rendu du Congres International de Fonderie de Liege 23-28 Juin 1930.) RENAUD. *Revue de Métallurgie*, Vol. 28, Apr. 1931, pages 226–238.

A brief description of the activities of the Congress is given followed by the extended abstracts of the papers presented at the Congress.

Some Physico-Chemical Changes in So-called Pearlitic Cast Irons. (Sur quelques modifications physico-chimiques des fontes dites perlitiques.) A. LE THOMAS. Pages 227–228.

The paper was published in full in the *Association Technique de Fonderie*, Vol. 5, Feb. 1931, pages 46–58 from which it was abstracted.

Simple and Practical Methods for Study of Cast Iron and Checking the Foundry Practice. (Methodes simples et pratiques pour l'etude de la fonte de fer et le controle de la fabrication des moulages. Nouveau procede de metallographie du graphite.) L. F. C. GIRARDET. Pages 228–230.

Test pieces made of the metal run from the cupola cannot be used for determination of the qualities of the castings. Besides the usual temperature control the metal is tested after tapping for shrinkage by Keep method and the depth of chill is measured with a pair of dividers on the end of a broken-off piece of it. On the finished casting the surface hardness is measured and a shear test run on special projections cast on the body of the castings. Much light is thrown on the structure of the graphite by the use of a reagent: 25 cc. HCl, 100 cc. H_2O, 10 g. CrO_3, 5 g. $NiCl_2$. A second etch reveals minutest particles of graphite invisible after an ordinary etch. For simplification of the classification of metallographic characteristics a series of 12 microphotographs with the increasing sizes of graphite, pearlite and the other constituents is shown.

High Strength Cast Irons. (Les Fontes á Haute Resistance. Progres Recents.) R. LEMOINE. Pages 230–232.

The best strength is obtained in irons having a pearlitic structure and ranging in carbon content between 2.5 and 3.4% C. The structure is in its turn dependent on the speed of cooling and on Si content. To assure a uniformly pearlitic structure a carbon lower than 2.7% and Si above 2% is recommended. Under these conditions the speed of normal cooling is without any effect on the structure. Electric furnace is to be preferred to other means for preparation of iron. Several modifications of melting practice are given. The proper ratio between Si and C is kept by the notch test. This is cast and broken. If the chill is the same the ratio is correct. If it decreases the carbon is eliminated slower than silicon and some addition of iron oxide is necessary. The increase of chill indicates the need for some Si addition. Cupola is available for the process either melting an ordinary iron with a large addition of steel scrap or cast iron of an appropriate analysis. In the first case 40 to 55% scrap is used with coke consumption of about 14%. The second method is much more expensive. Low carbon iron made in an electric furnace gives 35–38 kg./mm.^{2} The same but made in a cupola has the strength of 32–36 kg./mm.^{2}

Factors Influencing the Quenching Properties of Cast Irons. (Les facteurs qui influencent les proprietes trempantes des fontes.) A. L. NORBURY. Pages 233–234.

The paper appears to be a summation of the previous papers by the same author: "Constitutional Diagrams for Cast Irons and Quenched Steels," *Journal Iron and Steel Institute*, 1929; "The Effect of Melting Conditions on the Microstructure and Mechanical Strength of Grey Cast Iron Containing Various Amounts of Carbon and Silicon," *Journal Iron and Steel Institute*, 1930. See abstract in *Metals & Alloys*, Vol. 1, Mar. 1930, page 429.

Nickel Cast Irons. (Fontes au nickel. Etudes et applications recentes.) F. RENAUD. Page 234.

A review of the properties of: high strength pearlitic irons, high strength pearlitic irons graphitized in the ladle; hard chill cast irons; non-magnetic irons for electrical uses; corrosion resistant irons, high temperature resistant austenitic irons; irons suitable for heat treatment.

Evolution of Malleable in France. (L'Evolution de la malleable en France.) RAYMOND GAILLY. Page 235–236.

After the war the French manufacturers made a rapid progress in malleable industry following the American methods. At the beginning the quality was much below American standards but the equipment of the plants with laboratories and pyrometric control permitted production of entirely satisfactory material. Two reverberatory furnaces were built in 1922 with the capacity of 10 tons and in 1926–27 the furnaces were enlarged to 20 tons and put on pulverized coal. In the latest years much work was done on application of rotary melting furnaces. Annealing furnaces followed the same line of development and are at the present of the capacity of 30 tons being fired with pulverized coal. The difficulties in obtaining satisfactory help resulted in wide introduction of hydraulic and then of compressed air molding machines. None of the present French foundries use chill casting. The industry is rapidly developing.

Some Remarks on the Foundry Defeat Called Dark Spots. (Quelques remarques sur un default de fonderie "le noir de la malleable.") M. KAGAN & R. DEPREZ. Page 236.

Sometimes on breaking the malleable casting as cast one can observe dark areas which are one of the most common defects of this type of castings. They are caused either by cracking of the casting or by the blowholes present in the metal. Means suitable for elimination of these defects would simultaneously cure the dark spots.

High Strength Malleable Iron. (La malleable á haute resistance.) E. PIWOWARSKY. Page 237.

There are many reasons why black heart malleable is open to more improvements than the white heart. Until a recent date the maximum content of Mn in black heart was 0.2–0.3%. Its increase to 0.4–0.6% considerably reduced the annealing time. With the present practice black heart malleable made in Germany has a tensile strength of 38–43 kg./mm.^{2} and elongation in 60 mm. 11–18% while white heart has 42–50 kg./mm.^{2} and 5.9–6.5% elongation depending on the furnace used for its melting. The time of annealing can be reduced by increasing Si content and decreasing carbon. The author introduced in practice a method in which a considerable improvement in the properties can be obtained by heating the castings at the beginning as high as possible and then keeping the temperature fluctuating just above and below the pearlitic range which greatly increases the decomposition speed of pearlite. Stabilizing action of Cr can be easily overcome by the increase of Si or Ni much improving the final product. Ni-containing irons are less subject to surface oxidation and therefore are probably suitable for making of white heart castings.

A Contribution to the History of Malleable Foundries in the Liege District. (Contribution á l'histoire de la fonderie de malleable au pays de Liege.) Page 238.

Historical sketch showing the influence of English practice on the development of Belgian malleable industry. JDG(22)

Steel Foundry Casts Anvil Block. *Foundry*, Vol. 58, Nov. 15, 1930, page 73.

Describes the production of an anvil block by the Otis Steel Co., Cleveland. The casting is 6 ft. wide, 7 ft. high and 14 ft. long, weighing 15 tons. It was made for the use of the Taylor Forge & Pipe Works, Chicago. VSP(22)

Cast Pipe to Carry Telephone Cables under Harlem River. JOHN TIRRELL (Warren Foundry & Pipe Co.). *Steel*, Vol. 87, Nov. 6, 1930, pages 50, 52.
Abstract of paper read before joint meeting of Newark Foundrymen's Association and Metropolitan Section, American Society of Mechanical Engineers. Describes manufacture of cast-iron pipe of bell and spigot type, 84 in. in diameter. Pipes and curves were poured bell end up; flasks, corebars and patterns were especially made. Ramming was done by hand. A 7- and a 5-ton ladle were used for pouring. MS(22)

Hardening Gray Iron May Have Industrial Applications. A. F. SHORE. *Foundry*, Vol. 58, Dec. 15, 1930, pages 74–76.
Describes tests conducted on hardening properties of gray Fe. Results of hardening gray Fe due to presence of combined C, cast in Fe chill mold, attained hardness of 48 scleroscope to a depth of 1/16 in. It was found that subjecting it to a temperature of 1750° F. for 2 or 3 hrs. the hardness was brought down to 35 scleroscope. Same annealing treatment was applied to an alloy containing 4.50% Ni and 1.50% Cr. The alloy failed to respond to annealing treatment for the purpose of machining. The effect of Ni in gray Fe is the same as in steel. Wear resistance depends not only upon hardness of cylinder walls but also on combined C in the walls. According to author if gray Fe contains free silica or other gritty particles, it becomes the controlling factor in wear resistance tests. VSP(22)

Composition and Properties of Sand for Aluminum Casting. (Zusammensetzung und Eigenschaften des Sandes für Aluminium-Formguss.) A. RODEHUESER. *Aluminium, Hauszeitschrift der V. A. W. Erftwerk*, Vol 3, Jan.-Mar. 1931, pages 75–83.
The sand for molds for casting aluminum should be fine and not contain too much clay in order to give sufficient strength to the mold and a smooth surface to the cast. Good porosity is advantageous but not absolutely necessary. Humidity should be kept low. Instructions for preparation and mixing of different sands and the results of tests are given. Ha(22)

Reconditioning Die Casting Machines. W. E. WARNER. *Canadian Foundryman*, Vol. 22, Mar. 1931, page 12.
A note on the subject, in which the methods which should be adopted in the examination of die casting machines when being repaired are considered. OWE(22)

Permanent Molds and the Influence of Cooling Velocity on Gray Iron Castings. (Ueber Dauerformen und den Einfluss der Abkühlungsgeschwindigkeit bei Grauguss.) EMIL KOETTGEN. Doctor's Thesis published by Giesserei Verlag, Düsseldorf, 1930, 14 pages.
The theoretical bases of gray casting are explained and means are developed to precipitate graphite in fine form. This purpose is carried out in the process by means of permanent molds controlling the cooling velocity. The latter depends on the wall-thickness of the piece, the mold, preheating, heat conductivity of the mold, pouring temperature, etc. All of these factors were represented in curves. The influence of pouring temperature was especially investigated. It could be stated that, with decreasing pouring temperature, the Brinell hardness increased, if the material was always melted at the same temperature. This condition was reversed if it was poured with the same temperature at which it was melted. The origination of the finest structure, eutectic graphite, was examined at increased cooling and at overheating. Recalescent point measurements with oscillograph confirmed the assumption that graphite is precipitated directly from the melt. Overheating of the melt had no influence on this. Some views are discussed with regard to design and economy of permanent forms Ha(22)

Preventing Uneven Chill in Chilled Moulds. *Foundry Trade Journal*, Vol. 44, June 18, 1931, page 414.
An article describing a method which can be used to ensure an even chill on molds. The article is illustrated by one diagram. OWE(22)

Making Pipes in Green Sand. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, pages 237–238.
An article reporting a talk on the above subject, in which a description is given of the production of straight pipes, bent pipes and syphon pots in green sand. A brief discussion is also recorded. The article is accompanied by 7 diagrams. OWE(22)

Sand-Spun Cast-Iron Pipes. *Foundry Trade Journal*, Vol. 43, Sept. 4, 1930, page 161.
Describes Staveley Works of the Staveley Coal & Iron Co. used for the manufacture of cast Fe pipes in sand lined molds by the centrifugal process. The pipes made are of 4, 6, 8, 10 and 12 in. sizes, of the socket and spigot type. Advantages of the process are that the pipe will not chill and annealing is not necessary. Greater strength, toughness and elasticity is gained by the sand-spun process for lesser thickness of metal. VSP(22)

Magnetically-Operated Moulding Machines. An Important British Development. *Foundry Trade Journal*, Vol. 43, Sept. 18, 1930, pages 195–196.
Describes patented magnetically operated molding machines, which use the power from the mains by the intermediary of either solenoids or electromagnets. This was developed by the British Insulated Cables, Ltd. VSP(22)

The Continuous Process as Applied to Malleable Practice. B. R. MAYNE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Oct. 1930, pages 561–576.
For continuous supply of metal for pouring, cupolas are used to melt the cold stock and electric furnaces are used for refining and raising the temperature. Close laboratory control is required. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 86. CHL(22)

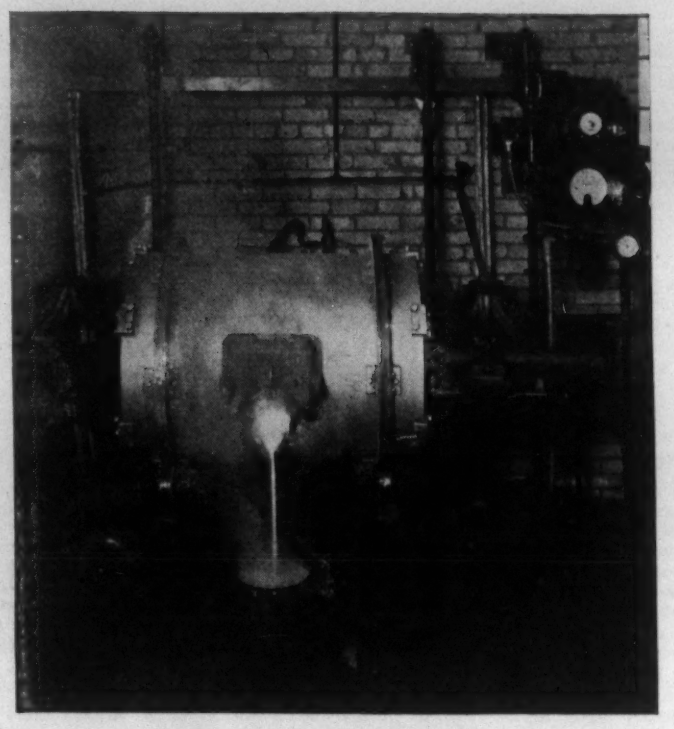
Cupola Melting of Brass. T. MAULAND (International Harvester Company). *American Metal Market*, Vol. 38, May 14, 1931, pages 3–4.
Gives details of fuel, lining and patching, lighting of bed, charges, losses and pouring temperature. Advantages of cupola melting are: (a) rapid and economical melting; (b) ease and ability to get hot metal; (c) absence of heat and noise; (d) absence of fumes (except when tapping); (e) low melting loss; (f) quality of product. Process not recommended for melting alloys high in Zn. DTR(22)

Speedier Malleable Melting and Annealing. L. H. MARSHALL. *Metal Progress*, Vol. 18, Nov. 1930, pages 90–94.
The author discusses the 2 phases of malleable manufacture, melting and annealing. Use of soda in melting discussed. Methods of shortening the anneal are given. WLC(22)

The Production of an Aluminium Alloy Casting. E. JACKSON. *Metal Industry*, London, Vol. 38, May 15, 1931, page 508; *Foundry Trade Journal*, Vol. 44, June 4, 1931, page 392.
Paper read before Institute of British Foundrymen, Junior Section, April 25, 1931. Molds should be rammed lightly and vented well. Castings are discolored if left in mold too long. Runners and risers are best dressed off by means of a band saw. OWE+PRK(22)

Core-binders. H. H. EBERT. *Iron & Steel Industry & British Foundryman*, Vol. 3, Sept. 1930, pages 363–364.
Brief review of principal core binding materials; sulphite liquor cores; use of molasses and resin; flour and starch; tar, linseed and other oils; composition of typical mixtures. CHL(22)

DETROIT Rocking Electric FURNACES



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These furnaces manufactured in capacities from 250 lbs. per hour to 6000 lbs. per hour, offer unusual economy in the production of grey iron, malleable iron, alloy steel, or non-ferrous castings showing the highest possible quality. The rocking action of the

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FURNACES & FUELS (23)

The Electric Furnace as a Metallurgical Tool in the Steel Industry. CHARLES MCKNIGHT. *Iron & Steel Engineer*, Vol. 8, May 1931, pages 224–227.

Paper read before the Pittsburgh Section, Jan. 21, 1931. The author discusses the uses of the various electric furnaces for melting alloy steel, resistance, indirect arc, direct arc and induction. The necessity for careful and interested operators of such furnaces is stressed. WLC(23)

Various Heat Treatment Furnaces Used in the Manufacture of Telephone Equipment. W. A. TIMM (Western Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 351–368.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, September 1930. Includes discussion. The author describes the heat treating equipment used in manufacture of 25,000 different items and the methods of selection of this equipment. WLC(23)

Electrical Apparatus for the Coreless Induction Furnace. T. R. STANSEL (General Electric Co.). *Iron & Steel Engineer*, Vol. 7, Nov. 1930, pages 519–524.

Refers to power sizes of coreless induction furnaces of 50 kva and greater. Discusses the principle of induction furnace and calculation of various constants. Generators and capacitors for high frequency induction furnace installations are described. WLC(23)

Low Temperature Gas Furnaces for Nitriding and Drawing. JAMES H. KNAPP. *Metal Progress*, Vol. 19, Feb. 1931, pages 38–39, 156; *Steel*, Vol. 88, Feb. 19, 1931, pages 38–40.

A paper presented before the Western Metal Congress in San Francisco, Feb. 16, 1931 and to appear in the Transactions in greater detail and with discussion. The author points out that 2 new features must be built into a gas furnace to operate satisfactorily at 800–1000° F, (a) some method of reducing the spread between the flame and work temperatures, and (b) some means of uniform and rapid circulation. Advantages of the circulation and convection heating at these temperatures are mentioned. A description of a furnace incorporating these features is illustrated with a diagram. The furnace has been satisfactorily operated at these temperatures for 6 months. A study of the temperature uniformity in the furnace is reported. Accessary and control equipment are described. WLC(23)

"Russ" Type Induction Furnace for Making Special Steels. (Four electrique "Russ" à induction pour l'affinage d'aciers speciaux.) *Journal du Four Electrique*, Vol. 40, May 1931, page 176.

A brief description of a furnace particularly suitable for duplex process and using standard or low frequency current. JDG(23)

A Review of Certain Gas Producer Practice. V. WINDETT (Wellman Engineering Company). *Preprint* for May 1931 Meeting, *American Iron & Steel Institute*, 69 pages.

Describes principles of design and operation of modern mechanical gas producers for open-hearth furnace and other use. Especial emphasis is laid on the ability to use low grade, high ash, low volatile coals even though the coal is nearly all fines. Detailed data are given on 23 coals. Some 33 pages of tables and 17 plots are included on performance of producers. HWG(23)

The Industrial Gas Field—Its Activities and Future Possibilities. J. E. WHITE. *Gas Journal*, Vol. 194, May 6, 1931, pages 371–374.

Includes discussion. Paper presented before North of England Gas Managers' Association. Describes industrial possibilities and large gas undertakings, heat treatment of finished forgings, use of gas furnaces and manufacture of parts in gas furnaces. MB(23)

Electric Annealing of Aluminium. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, page 244.

A description of a large resistance furnace for annealing aluminum sheets, manufactured by the General Electric Company and erected at Dolgarrog, Wales, for the Aluminium Corporation, Limited. OWE(23)

Bronze Melted Economically in High Frequency Furnace. J. H. WILLIAMS (Gen. Fire Extinquisher Co.). *Metal Progress*, Vol. 19, Jan. 1931, pages 57–60.

The application of the induction furnace to the production of small bronze castings for fire protection systems is described and discussed. WLC(23)

A Novel Drying Stove. *Foundry Trade Journal*, Vol. 44, June 4, 1931, pages 385–386.

An article illustrated by 2 photographs and 1 diagram and describing a vertical continuous drying stove which is used in a foundry manufacturing the heavier type of casting for automobile work. OWE(23)

The Brackelsberg Furnace at Bingley. *Foundry Trade Journal*, Vol. 44 Apr. 9, 1931, pages 257, 262.

A description of the Brackelsberg furnace which has been installed for Messrs. Clegg and Howgate, Limited, Bingley, Yorks., accompanied by 3 diagrams. OWE(23)

The Theory of Electrical Heating. (Zur Theorie der elektrischen Heizung.) F. WALTER. *Elektrotechnische Zeitschrift*, Vol. 52, July 9, 1931, pages 911–912; *Archiv für Elektrotechnik*, Vol. 24, No. 5, 1931, page 574.

The heating of a body by induction and conduction is determined by the absorption of that energy which the body takes from the electric energy field. The conditions are theoretically investigated and formulas are developed for the calculation of effective resistance, self-induction coefficient and alternating current resistance of iron sheets of definite dimensions. Ha(23)

Ash in Boiler Operation. (Asche im Kesselbetrieb.) FRIEDRICH SCHULTE. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Mar. 1931, pages 67–68.

Paper presented at Düsseldorf, Jan. 7, 1931. Tells how to overcome difficulties and daily problems. An extensive table giving the chemical composition of various slags occurring in iron and steel metallurgical furnaces is printed. MAB(23)

The Design and Operation of Open-Hearth Furnaces. C. W. VEACH. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 15–18.

Cites important landmarks in history of steel making from early work of Siemens in 1857 to first commercial manufacture of basic open-hearth steel by Carnegie, Phipps & Co. in 1888. In 1890 basic open-hearth furnaces produced 90,000 tons of steel in furnaces of 15–35 tons capacity as against present annual production of 30,000,000 tons in furnaces of 300–400 tons capacity. Open-hearth furnaces require 6,500,000 B.t.u. per ton of steel. The author expects improvements in furnace design and combustion control will lower this figure to 5,000,000 B.t.u. Also expects larger number of heats will be obtained in a "furnace campaign." Small, basic open-hearth furnaces now average 450 heats per furnace campaign. By better flame control, minor changes in construction and greater care in safeguarding furnace lining against overheating, the author has achieved over 800 heats per furnace campaign. A comparison was made of three "campaigns" in a 31 ton furnace yielding 1350 heats in 81 weeks under the old system against two "campaigns" yielding 1600 heats in 84 weeks under new practice. Cost analyses show a decrease in maintenance expense from $0.45/ton to $0.322/ton, or a saving of $0.128/ton. There was also a gain in production of 5790 tons over the average rating for 84 weeks. JN(23)

REFRACTORIES & FURNACE MATERIALS (24)

Comparative Tests for Determining Resistance of Fireclay Brick to Thermal Spalling. R. H. HEINDL (Bureau of Stanadrds). *Preprint* No. 64 for June 1931 Meeting, *American Society for Testing Materials*, 9 pages.

Comparison of A. S. T. M. spalling test, test promulgated by U.S. Federal Specifications Board, and modifications of these. It is concluded that the Federal method needs revision. A good method seems to be to heat from one end till that end is at 1400° C., hold 5 hours, cool slowly. Then heat the end again to 850° C. and quench it in 2" of running cold water. Allow to steam in air 5 minutes and reheat for 1 hr. to 850° C. Quench and repeat the cycle till the end is completely spalled, removing from time to time pieces that are so loosened that they will not support the weight of the brick. HWG(24)

Care and Maintenance of Fuel-Fired Furnace Linings in the Nonferrous Foundry. H. E. WHITE. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 1, Nov. 1930, pages 644–653.

Spalling and improper atmospheres are the chief causes for failure of furnace linings. Factors conducive to long life are listed and discussed. CHL(24)

GASES IN METALS (25)

The Adherence and Nature of Hydrogen Absorbed by Platinum Metals. (Haftfestigkeit und Natur des von den Platinmetallen sorbierten Wasserstoffs.) E. MÜLLER & K. SCHWABE (Technische Hochschule Dresden). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 154, Apr. 1931, pages 143–166.

All platinum metals absorb large quantities of hydrogen to the same degree as palladium does, presumably their oxides have been reduced by hydrogen at low temperatures. At low pressure, the H_2 absorbed is liberated in palladium completely, in platinum partly, but not at all in rhodium, ruthenium, iridium and osmium. The authors explain this different behavior as a difference between "mol-absorption" and "atom-absorption." The molecularly absorbed hydrogen (Pd and Pt) is only loosely fixed and dependent on pressure. The atom-absorption phenomena takes place only at the surface and discloses no relationship to pressure (Rh, Ru, Ir, Os and partly Pd, Pt). EF(25)

Gases in Metals. PAUL D. MERICA. *Mining & Metallurgy*, Vol. 12, Apr. 1931, pages 189–191.

Second of a series of discussions by the Institute of Metals Division of the A. I. M. E. The occurrence of blisters on rolled plates or sheet metal, as well as in enameled coatings is due to the presence of gases in metals. Exposure of metals to reducing gases at high temperatures may render metals brittle, notably Cu. Magnetic properties of highly magnetic materials are seriously affected by gases such as H, N and CO. The presence of 0.0002% H in casting renders it porous. Gases are absorbed to a greater extent at higher temperatures that at lower temperatures. Temperature, pressure and the presence of other elements, either in the molten metal or in the gaseous atmospheres, may have a great effect on the solubility of gases because of the effect on the chemical reactions involved. VSP(25)

Remarks Regarding the Influence of Occluded Gas on the Mechanical Properties of Metallurgical Products. (Remarques relatives á l' influence des gaz occlus sur les propriétés mécaniques des produits métallurgiques.) L. GUILLET & J. COURNOT. *Comptes Rendus*, Vol. 192, Mar. 30, 1931, pages 787–789.

A contribution to the discussion of the effect of occluded gas on the mechanical properties of electrolytic products and in particular of electrolytic iron, resulting from a recent paper by Messrs. Guichard, Clausmann, Billon and Lanthony, in which doubt was cast upon the relationship between the remarkable properties of electrolytic metals and their occluded gas content. The authors suggest that further experimentation is required and in conclusion point out that the results referred to by Guichard and his collaborators do not explain the effect of high frequency current upon the hardness of the electrolytic metals. OWE(25)

Investigations on Helium. IX. On the Helium Content in Meteoric Iron and the Accompanying Components of Iron Meteors as well as in Metals on Earth. (Heliumuntersuchungen. IX. Ueber den Heliumgehalt im Eisen und in den Akzessorischen Bestandteilen von Eisenmeteoriten sowie in irdischen Metallen.) F. PANETH & WM. D. URRY. *Zeitschrift für physikalische Chemie*, Sec. A, Vol. 152, Jan. 1931, pages 127–149.

Helium content in iron from 38 different meteors was determined. The quantities amounted to 0.23×10^{-6} and 36×10^{-6} cm. He, except one sample from Savik. The investigations on the accompanying components in meteors mainly confined to troilite. Furthermore schreibersite, pallasite and mesosiderite were studied. No He was found in 2 kinds of Cu from this earth (Michigan), while 2 sorts of Fe (Disco-Greenland and Kassel) contained quantities of He sufficient for computing their geological age. The second part refers to the study of He in meteors in relationship to temperature up to 1000° C. The different behavior of the surface regions and the core is considered and conclusions are drawn to geological age determinations. EF(25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Experiments with Chromium in Gray Iron. T. F. JENNINGS. *Foundry*, Vol. 59, Mar. 1, 1931, pages 93–95.

From a paper read before the American Foundrymen's Association. Investigations show that certain limits exist as to the quantity of Cr that may be added to cast Fe if machinability is to be retained in a given thickness of section. With Fe containing C 2.86%, Si 2.7%, Mn 0.50%, S 0.062%, P 0.794%, the maximum permissible addition of Cr before variation in case of machinability occurred between 0.52 and 0.63%. Transverse strength and deflection is augmented by addition of Cr up to 0.50%. Resistance to atmospheric corrosion is improved by adding over 1% Cr. Considers, also, the effect of Cr on fluidity. VSP(27)

Effect of Composition on Aluminum-Base Die-Casting Alloys. D. L. COLWELL (Stewart Die Casting Corp.). *Preprint* No. 225 for June 1931 Meeting, *American Society for Testing Materials*, 10 pages, 6 references.

The voluminous data obtained by A. S. T. M. Committee B-6 on Die Castings includes results on many specimens that are quite wide of the nominal composition. Half of the alloys under test are outside the limits set. Out of 12 alloys supposed to be made up to certain limits by 5 producers, one producer made only one of the 12 within the desired limits, another only 2, 2 others 6 and 8, and one producer came within the limits on all 12. The data are analyzed with this in mind. An alloy of 1–2% Cu, ¾–2% Si, 1¾–2½% Ni, 2½% Fe, is not as tough in impact as the uncorrected committee data would indicate and those of 0.6% Cu, 11–13% Si, 05% Ni, 2% Fe and 7–9% Cu, 1–2% Si, 1% Ni, 2½% Fe, are tougher. The 11–13% Si alloy is a better alloy than it would be rated to be by the uncorrected figures; it has about 36,000 lbs/in.² tensile, 2% elongation and 3¾ Charpy or 2¾ Izod, all figures for the true composition being appreciably better than the averages that included specimens off in composition. The 8% Cu alloy is also better than the off-composition averages. HWG(27)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Effect of Temperature on Some Properties of Iron-Chromium-Nickel Alloys. N. B. PILLING & R. WORTHINGTON (International Nickel Co.) *Preprint* for A.S.T.M.-A.S.M.E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 347–402, 18 tables, 27 figures, 77 references.

Detailed data on the properties of some 250 alloys of this class are tabulated and plotted. The data were obtained by short-time tensile, regular creep or accelerated creep tests. Short-time tensile tests have close correlation with hot-working properties. Creep tests by different observers are difficult to intercompare. Many observers report data on the basis of an assumed "limiting creep stress," which probably does not exist. Stress for a given rate of flow is a better way of reporting data. Both Fe and Ni are important for good creep strength in Cr alloys, 80 Ni 20 Cr is relatively weak. Castings show better creep strength than wrought metal. This is the more pronounced, the higher the Cr. In alloys with 20 to 30% Cr and 20% Ni the presence of 1/2% carbon gives better creep strength than very low carbon, but in very high Ni alloys, this is reversed. Tungsten has very marked strengthening effect. In alloys with 20% Cr at 1200° F. the short-time tensile strength rises with increased Ni, but creep resistance rises but slightly as Ni increases from 8 to 40%. The trend in cast alloys may be different. Resistance to high temperature oxidation is conferred by Cr and improved by Si. In high Ni alloys, increase of Cr above 30% does not bring much further improvement. Resistance to sulphur gases is increased as Cr, Fe, Si, and Al increase; i. e., as Ni decreases. The attack depends much on the degree of oxidation of the gas, reducing conditions such as presence of hydrogen facilitate attack. Attack may be greater between 1100° and 1500° F. than above or below. Cast 18–8 alloy is generally produced in the ranges Cr 17–20%, Ni 7–10 1/2; Si 1/4–3/4; Mn under 0.65%; C under 0.20%. Design stresses for cast heat-resistant alloys vary widely. For alloys with about 1/2% C the following ranges at 1800° F. are used by different designers, 17 Cr 35 Ni, 290 to 1250 lbs./in.^{2}; 8 Cr 66 Ni, 350 to 1250 lbs./in.^{2}; for 28 Cr 10 Ni, 250 to 1100 lbs./in.^{2}. The vast amount of detailed data packed into this paper makes any abstract inadequate. HWG(29)

Properties of Copper and Some of Its Important Industrial Alloys at Elevated Temperatures. W. B. PRICE (Scovill Mfg. Co.). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 234–244, 12 figures.

Short-time tensile tests, hitherto unpublished, and carried up to 1600° F. in order to get information useful in planning hot forging, extrusion and similar operations, are presented on high purity copper; naval brass; Admiralty; Muntz; 2 and 1; leaded 70:30; low brass; cap gilding; and aluminum brass. Copper and cap gilding were carried above 1800° F. As low as 0.1% Pb in 2 and 1 brass ruins the high temperature ductility. Without lead, ductility increases with temperature. The brittleness of α-brass just below the recrystallization temperature is greatly emphasized by cold-working. Cap gilding (90 Cu 10 Zn) holds its strength well, having 10,000 lbs./in.^{2} tensile at 1100° F. Most of the other alloys have only 5000 lbs./in.^{2} or less at that temperature. The data on pure copper show greater high temperature ductility than do other published data, which is ascribed to the high purity of the material used. HWG(29)

Discussion of Paper by W. B. Price on High Temperature Properties of Copper and Various Brasses. W. H. BASSETT (American Brass Co.). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 245–254. 7 figures, 4 tables, 13 references.

Adds hitherto unpublished data on short-time tests from room temperature to 600° F. on most of the alloys discussed by Price, also on a nickel brass, on 90 Cu 10 Sn, 80 Cu 20 Ni, and on German silvers with 18 and 30% Ni. Alloy of Cu with 5% Zn and 20 to 30% Ni retain half their strength at 930° F. One of 96% Cu, 3% Si, 1% Mn retains half at 750° F. One of 90% Cu 10% Al does not scale at high temperatures and has as high strength at 1650° F. as one with 5% Al has at room temperature. HWG(29)

The Deterioration of Cast Iron on Repeated and Prolonged Heating. C. E. PEARSON. *Foundry Trade Journal*, Vol. 44, Apr. 16, 1931, pages 271–272.

Read before the Newcastle section of the Institute of British Foundrymen. Metals decrease in strength and hardness as temperature is raised but the loss is regained on cooling. Cites results of other investigators. Growth occurs in oxidizing and reducing atmospheres and, also, in vacuo. Decomposition of Fe_3C may be the cause of growth. Other factors causing growth are the size and distribution of graphite flakes. Considers the effect of Mn, P, Ni, Cr and Si. Growth is retarded in Fe which has been superheated prior to casting owing to the form of graphite distribution. VSP(29)

Trends in Engineering Requirements for Metals for the Power-Plant Industry. H. J. KERR (Babcock & Wilcox Co.). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 9–13.

Increase in boiler efficiency is contemplated by increase in steam pressure and temperature, or by use of some other material than steam. Limitations in pressure and temperature can only be raised by use of special steel. High pressure drums, headers, etc., require weldable, ductile material that will stand cold working, obtainable in large, thick plates and of 100,000 lbs./in.^{2} tensile, stable for indefinite service at 750° F. High pressure tubes exposed to radiant heat must stand 1000° F., showing a creep rate of not over 1% in 100,000 hrs. at 10,000 lbs./in.^{2}, and be stable, be readily manufactured, be good for fusion welding, withstand contact with steam and boiler water, sulphur gas corrosion and stand some cold working. Carbon steel superheater tubes behave well to 850° F. with proper design, but temperatures of 1200–1300° F. are desired and the tubes should not at those temperatures, exceed the creep rate at the load given above for high pressure tubes. Other requirements are about as for those tubes, extended to 1300° F. Stability up to 1500° F. is wanted. Superheater headers not subjected to gas temperatures have much the same requirements as for high pressure tubes. For binary cycles, with mercury or other material beside water, tube heating elements have the 1300° F. requirements above stated for superheater tubes save that the limiting creep stress is 5000 lbs./in.^{2}, and the elements must resist corrosion by the material used. Soot blowers, hangers and some baffles should stand up when exposed to combustion gases at 1700–1900° F., but there is no rigid stress requirement. These metallurgical requirements are nearing a technical solution, but to pay the power plant for their use, they must be available at a cost that will return interest on the investment. HWG(29)

A Note on the Silver Rich Aluminium-Silver Alloys above 600° C. T. P. HOAR & R. K. ROWNTREE. *Metal Industry*, London, Vol. 38, May 8, 1931, pages 481–482.

Using 99.95% Al to make Ag-Al alloys up to 14.34% Al, thermal and micrographic examination showed the solidus to have 2 breaks: 6.2% Al and 779° C., and 10.8% Al and 729° C. The following table gives the phase boundaries:

	Boundary Determined		
% Al	$\alpha/\alpha+\beta$	$\alpha+\beta/\beta$	$\beta+\gamma/\gamma$
5.02	770–775° C.		
5.41	712–721		
6.01	603–625	777–779° C.	
6.90	.....	689–698	
7.40	.....	643–647	
9.50	.....	.....	675–689° C.

See also *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. PRK(29)

Wrought-Iron and Wrought-Steel Pipe and Tubing. Report of Sectional Committee, A. S. T. M. H. H. MORGAN, Chairman. *Preprint* No. 27 for June 1931 Meeting, *American Society for Testing Materials*, 2 pages.

Various specifications are being prepared. A sub-group is to report in June in regard to allowable stresses in piping for temperatures above 750° F. A formula has been adopted for use in setting up schedules for pipe wall thickness for various pressure-stress relations. HWG(29)

Effect of Temperature on the Properties of Nitrided Alloys. O. E. HARDER (Battelle Memorial Institute). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 463–485, 10 tables, 5 figures, 38 references.

The nitride case retains its high hardness when tested hot up to at least 750° F. It retains full hardness after 200 hrs. at 840° F. and retains 55 to 70% of its initial hardness after heating 1 hr. at 1500° F. and cooling. Samples nitrided at the higher temperatures, initially not quite so hard as others, retain a greater percentage of their hardness. A core for a die casting machine used with an Al Si alloy at 1150° F. remained file hard after producing over 125,000 castings. At 930° F. the test hardness is higher than that of high speed steel. Little data are available on the high temperature properties of the nitriding steels. Since these contain Cr, Mo and Al their creep resistance would be expected to be good. A 0.25% C, 0.80% Mo, 1.20% Al steel without Cr gave 73,000 lbs./in.^{2} tensile at 1200° F. on short time test. A nitrided Cr-Al steel is reported as stretching 0.002 in. per inch. at 1000° F. under 10,000 lbs./in.^{2} load, in 4000 hours, then showing no further flow for an additional 5000 hrs. Nitride cases do not stand up in contact with combustion products of ethyl gas, but make good valves for use with straight run gas. Seizure of unlubricated coating surfaces at 750° F. is avoided with nitride cases operating against itself or several other materials. Nitrided steels have worked well in steam valves as high as 1000° F. with high pressures. In the oil industry nitrided pump plungers work without pitting in "sweet" oil at 750° F. and 900 lbs., but are attacked by "sour" oil. General discussion is included of many room temperature properties of nitrided steels. HWG(29)

Heat Resistant Steels, Their Properties, Production and Application. (Oxydationsbeständige Stähle, ihre Eigenschaften, Herstellung und Anwendung.) E. HOUDREMONT. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 206.

See *Metals & Alloys*, Vol. 2, Jan. 1931, pages 31–33. EF(29)

Working Stresses for Steel at High Temperatures. D. S. JACOBUS. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 2, *Fuel & Steam Power*, pages 295–304.

Includes discussion. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 19. (29)

High-Chromium Steels for Extreme Service Conditions. C. E. MACQUIGG (Union Carbide & Carbon Co.). *Preprint* for A.S.T.M.-A.S.M.E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 432–449, 6 tables, 20 references.

The Fe–Cr–C system is quite similar to the Fe–C system, save there is no analog to gray iron. The critical cooling rates are very different and the temperature from which the steel is cooled has more effect. The ratio of Cr to C is important. With less than 10 Cr to 1 C hardening occurs about as in carbon steel; with higher ratios, greater hardening occurs. There are 4 groups of commercially important high Cr steels: (A) Cr 5 to 7%, C below 0.3%; (B) Cr 12 to 16%, C below 0.10% in rustless iron, about 0.35%, in cutlery, about 2% in abrasion-resistant steels; (C) Cr 16 to 20%, C around 0.20% or under for wrought metal, about 0.80% for castings; (D) Cr, 25 to 30%, C around 0.35% or under for wrought metal, up to 1% in castings and to 2 1/2 or 3% for wear-resistant castings. Steel of class A, with 0.10% C, 0.34% Si, 0.79% Mn, 5.56% Cr, held 3 hrs. at 1650° F., air cooled then given a short time test at following temperatures, gave the following results.

Temp.	Tensile lbs./in.^{2}	Yield lbs./in.^{2}	Elong. % 2"	Red. Area %
Room	178,000	120,000	16	56 1/2
570° F.	185,000	147,000	12	43 1/2
750° F.	186,000	140,000	19	61
930° F.	164,500	120,000	15 1/2	56
1110° F.	70,700	....	19	75 1/2
1290° F.	27,500	....	35	91 1/2

With low enough carbon all 4 groups of steels are workable, group D forms into seamless tubing more readily than lower Cr steels. Room temperature, strength, thermal expansion and thermal conductivity, electrical resistance and corrosion resistance are discussed. Holding alloys with over 19% Cr at 750° to 1110° F. causes brittleness when cooled to room temperature, though the alloys are tough when actually in that temperature range. It can be removed by an anneal above 1290° F. The great resistance to oxidation and to attack by sulphur at high temperatures gives these alloys great value. They will not stand strongly reducing conditions above 1920° F. Comments on melting and casting practice are given. The problems resemble those of a steel foundry with the difficulties intensified. HWG(29)

On Vapor Tensions and Activities of a Volatile Component in Binary Alloys at Elevated Temperatures. (Ueber Dampfspannungen und Aktivitäten eine flüchtigen Komponente in binären Metallegierungen bei höheren Temperaturen.) K. JELLINEK & G. A. ROSNER (Technische Hochschule Danzig.) *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Jan. 1931, pages 67–94.

The vapor tensions of the binary alloys of Pb-Cd, Sn-Cd and Cu-Cd were determined between 500° and 700° C. and over the concentration range from 10–60 mol. %, while the Cu-Zn alloys were investigated between 600° and 800° C. The activity coefficients of Cd and Zn with reference to the systems investigated were established. The data gained on Cd in Sn and Pb-alloys are compared with the values of Taylor (*Journal American Chemical Society*, Vol. 45, 1923, page 2865). The evaporation heat and the mixing heat of Cd and in Zn with reference to the systems mentioned above were computed. EF(29)

Metallurgical Requirements for High Temperature Piping. F. W. MARTIN (Sargent & Lundy). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 14–22; *Heating, Piping & Air Conditioning*, Vol. 3, Aug. 1931, pages 673–677.

Steam plants are in operation in the U. S. at 1200 lbs. and 750° F., some under construction will run at 1400 lbs., 850° F. An experimental plant at 400 lbs., 1000° F. is building. (This uses 18–8 pipe and fittings.) In Europe, as high as 3200 lbs. at 700° F. is used. Creep is not important in piping; it is only necessary that the bursting point is not reached. 2 or 3% creep in 200,000 hrs. would be permissible. Seamless steel tubing is used up to 750° F. Cast or forged steel is used for fittings up to this temperature. The cast steel must not be given a liquid quench. For higher temperatures, a Cr-Ni cast steel is used that is as strong at 1000° F. as carbon steel is at 750° F. Differential expansion and galling are important in valves. Cast iron or nitrided steel each against itself and stainless steel against nitrided steel, resist galling. The seat ring must stand at least 9000 lbs./in.^{2} at operating temperatures. Materials for stems must machine well and resist corrosion. The valve body and bonnet, as well as the pipe sections are held by studs with nuts on each end. High carbon bolts become brittle. A 0.45 C, 1.50 Ni, 0.70 Cr heat-treated steel serves well. Nuts are usually carbon steel. WAT+WHG(29)

Thermal Expansion of Metals. N. L. MOCHEL (Westinghouse Elec. & Mfg. Co.). *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 Meeting, *American Society for Testing Materials*, pages 509–544, 9 figures, 21 references, 10 tables.

This paper contains 20 pages of tabulated data on thermal expansion of metals and on ferrous and non-ferrous alloys of all sorts, conveniently arranged for reference. Some hitherto unpublished data are included. After a general discussion, typical expansion curves are shown. Many engineering examples of difficulties met because of thermal expansion are cited. To plug holes in retorts, high Ni high Cr steel, of higher expansivity than the retort body, is used for high stress. Chilled surface iron rolls have been assumed to have trouble due to greater expansivity of chilled iron, but recent data indicate similar coefficients for white and gray iron. Piston and cylinder materials and clearances are discussed. Dilatometric methods of study throw light on metallurgical problems. Ingot and forging "clinks" are thermal expansion troubles. Low expansivity, Invar-type steels are discussed. HWG(29)

Pipe Lines for High-Pressure Steam. L. PERREAU. *Engineering and Boiler House Review*, Vol. 44, Mar. 1931, pages 574, 576, 578, 580.

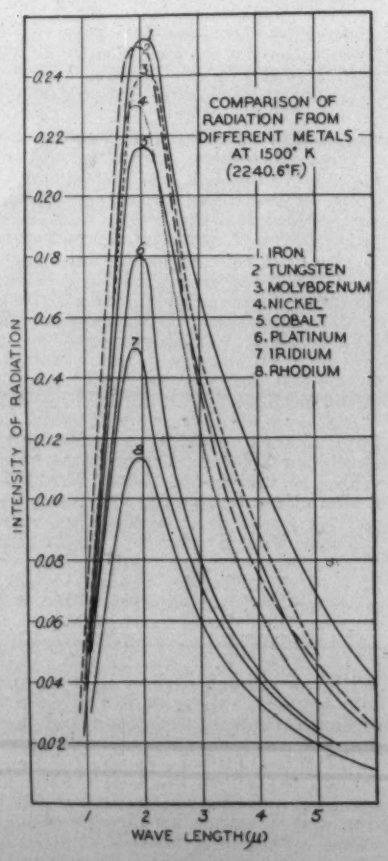
This article is based on notes on design and construction dealing with French practice. Tests have shown that, for saturated steam, the temperature of the wall differed from that of the steam only by about 0.5 to 1° C. For ordinary pressures and temperatures not exceeding 250° C., a formula for calculating the necessary thickness of the pipe is given as

$$e = \frac{D}{2}\left(\sqrt{\frac{R+p}{R-p}} - 1\right) \text{ or } e = \frac{pD}{2R-p}$$

where D is the internal diameter of the pipe (determined from the necessary volume of the steam to pass in a certain time), e is the thickness, p is internal pressure, R is the working stress. The latter must be chosen with regard to the variation in strength with temperature, according to $R_1 = R - 0.12(t - 325)$, where R is ultimate strength at normal temperature, R_1 at temperature t ° C. (for all temperatures from 325° to 500° C.). The methods of joining pipes together with separators are illustrated and figures given for Continental practice of safety coefficients. A diagram is added for elastic limit and ultimate strength of steels up to 500° C. Ha(29)

Spectral Distribution of the Energy Radiated from Metallic Surfaces at High Temperatures. G. R. GREENSLADE. *Heating, Piping and Air Conditioning*, Vol. 3, Jan. 1931, pages 50–58.

This paper contains scientific information on the subject of thermal radiation from metallic substances, from 1500° to as high as 3750° F. The test specimens were heated electrically in a sealed water cooled vacuum chamber. A comparison of the radiation of the metals tested is given in the accompanying chart. The value, K, is a constant depending upon the intensity of radiation and current applied. It was found that the total radiated energy as well as the form of the wave length-energy curve varied with the purity of the metal. WAT(29)



Corrosion and Heat Resistant Nickel-Copper-Chromium Cast Iron. J. S. VANICK & P. D. MERICA. *American Society for Steel Treating*, Vol. 18, 1930, pages 923–942; *Bulletin* No. 208 of the *International Nickel Company*, 11 pages.

Data and graphs are given for tensile strength up to 1100° F. on two types of cast iron: plain and heat resistant. Heat resistant, C 2.75–3.00, Si 1.25–2.00, Mn 1–1.5, Ni 12.0–15.0, Cu 5.0–7.0, Cr 1.5–4.0 percent. Data on corrosion resistance are given for a number of corrosive reagents. Data on oxidation and growth of these two types of cast iron are given at 1500° F. After 40 cycles of heating and cooling (8 hours per cycle at 1500° F.) the heat resistant cast iron showed no growth or effects of oxidation. The alloy cast iron has the machinability of plain cast iron as well as its physical properties. The thermal coefficient of expansion is 50% greater than plain cast iron (similar to that of bronze) for temperatures up to 600° C. The alloy cast iron is non-magnetic and has a high electrical resistivity (1¼ % of copper conductivity). This material is unusually well suited to welding by arc or acetylene and by the use of filler rod of the same composition. See also *Metals & Alloys*, Aug. 1931, page 141. WAT(29)

The Resistance of Ordinary Steel at High Temperatures. (Sur la résistance à chaud des aciers ordinaires.) L. GUILLET, J. GALIBOURG & M. SAMSOEN. *Comptes Rendus*, Vol. 192, Apr. 13, 1931, pages 861–863.

The authors describe an investigation involving the use of a modified Martin's extensometer designed by them and described in *Comptes Rendus*, Vol. 188, 1929, pages 1205–1208. In the present investigation a series of boiler steels have been tested and values for two mechanical characteristics of the steels at temperatures of 225°, 325°, 425° and 525° C., respectively, are tabulated. The 2 characteristics referred to are known as (1) the limit of instantaneous extension proportional to load (la limite des allongements instantanés proportionnels aux efforts)—when passing from one load to a higher, observations are made of the instantaneous extensions which, for loads between zero and a certain limiting value, are proportional to the excessive load which has just been applied, but are not proportional to the excessive load if and when loads exceeding this limit have been reached, and (2) the limit of instantaneous extension without creep in relation to time (la limite des allongements instantanés sans écoulement en fonction du temps)—after the instantaneous extension has been measured, provided the load exceeds a certain limiting value and is continuously applied to the sample under test, the sample extends continuously with time, but ultimately extension reaches a limit at which it stops. The authors submit that the following generalization has been proved—namely, that properly speaking, a true elastic limit does not exist, even for steels at ordinary temperatures, the apparent permanence of dimensions after a slight load has been applied being an illusion resulting from the imperfect sensitivity of our measuring instruments. OWE(29)

LEACHING (30)

Extraction of Soluble Copper from Ores in Leaching by Percolation. JOHN D. SULLIVAN & KENNETH O. BAYARD. *Bureau of Mines Report of Investigations* No. 3073, Apr. 1931, 43 pages.

The physical nature of the rock, its porosity, degree of kaolinization and sericitization, and the amount of natural slime determine the amount of solution that will be retained, and the difficulty that will be found in washing out the soluble salts. The rate of removal of soluble copper decreased with increases in the amount of slime present and increased only slightly with temperature. Wet charging the ore into the vat was advantageous. In washing the cycles of submergence and draining should be as close to each other as possible consistent with fairly thorough mixing of the copper sulphate in the wash solution and thorough draining of the solution. The copper sulphate concentration was greater at the bottom than top of the ore column. Circulating the solutions increased extraction rates. Piston-displacement washing removed copper more rapidly than batch washing but the volume of wash solution required was greater. Downward and upward percolation of wash solutions gave virtually identical extraction rates. Less copper sulphate was precipitated in the ore when the impregnating solutions were acidic. AHE(30)

Factors Governing the Entry of Solutions into Ores during Leaching. JOHN D. SULLIVAN & ENRIQUE OLIVAR OSTREA. *United States Bureau of Mines, Technical Paper* 498, May 1931, 23 pages.

Replacing the air in the voids within pieces of Warren unweathered ore with SO_2 increases the rate of solution penetration. AHE(30)

Factors Involved in the Heap Leaching of Copper Ores. JOHN D. SULLIVAN. *U. S. Bureau of Mines Information Circular* 6425, Apr. 1931, 12 pages.

Enough solution cannot enter a rock at one time to dissolve the Cu minerals completely unless the Cu content is very low. Frequent renewals of solution and much time are required. In heap leaching with oxidized ores the slowest step is probably the removal of the soluble salts. If the Cu exists as sulphide (chalcopyrite excepted) about 20 days will be required for complete dissolution of the Cu. The rate of dissolution of any Cu mineral by a given solvent cannot be markedly changed. Displacing air in heaps with SO_2 from waste smelter gases increases the rate of solution penetration. Finer crushing or recirculation of solutions (if containing some free acid) speed extractions. AHE(30)

REDUCTION METALLURGY (31)

Smelting in the Lead Blast Furnace. Handling Rich Charges. VII. Methods of Charging, Rate of Subsidence of the Charge, and Accretions Made. G. L. OLDRIGHT & VIRGIL MILLER. *U. S. Bureau of Mines Report of Investigations* 3094, Apr. 1931, 11 pages.

Under the conditions of operation at Kellogg, Idaho, a fusible charge is employed containing about 50% Pb that is more difficult to desulphurize than is a poorer charge, and is also more semi-malleable at softening temperatures. A furnace column 7–11 feet high is used. A fast rate of smelting without too great a loss of Pb in the slag is obtained using 9–12% coke in the charge. The rate of subsidence at any one spot in the furnace is fairly uniform for the larger part of the time, although the rate of descent of different sections is vastly different. The sudden descent of the column toward the slag-tap end of the furnace into a space left vacant by the charge smelting away under it, usually causes a sudden increase in the Pb content of the slag issuing from the furnace. Accretions on the shaft walls may be formed by accumulations of volatilized material from the tuyères and residual matter left by the descending charge. At Kellogg these are thickest above the normal level of the top of the charge. The sulphide content (particularly of Zn) increases fairly steadily from the top of the accretion to a little lower than the junction of the 2 tiers of H_2O jackets. From this point down sulphides decrease to a normal slag at the tuyères. Accretions in the crucible start from the top and build downward. They form early and rapidly. They are predominantly sulphides, ZnS being the most notable. The volume free of accretions in which the molten Pb collects is at the bottom of the crucible, and there are but few channels through the accretions to connect this free space with the molten charge at the tuyères. AHE(31)

Iron-Ore Reduction in the Hot-Blast Furnace. WM. MCCONNACHIE. *Iron & Steel of Canada*, Vol. 14, Feb. 1931, pages 21, 42–43.

An article taken from *Iron & Coal Trades Review*, dealing with a study of the conditions obtaining in blast furnaces using as fuel the dry-burning bituminous coal in general use in Scotland, which furnaces, while not having large outputs, can produce pig-iron with a much less consumption of coke carbon—fed as raw coal—than any other. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 91. OWE(31)

Vanadium Recovery from Titaniferous Iron Ore. BJÖRN P. F. KJELLBERG. *Engineering & Mining Journal*, Vol. 131, May 25, 1931, page 460.

An outline of a wet process for extracting vanadium from titaniferous iron ores and concentrates, with the production of vanadium pentoxide and a residue which when melted directly, yields a high-quality steel and a rich titanium slag. Titaniferous iron ores containing vanadium are particularly suited for direct steel production. To the solution obtained by cold leaching of the calcine sufficient aqueous solution of sulphur dioxide is added to permit precipitation of the vanadium compounds with lime. The precipitate analyzing about 40% V when dried, carries a small amount of sulphur which may be expelled by calcining prior to the manufacture of ferro-vanadium. Pure vanadium pentoxide is being extensively used as a catalyst. Its preparation is outlined. WHB(31)

A Practical Method of Solving the Emergency Manganese Problem. C. H. Herty, Jr. *U. S. Bureau of Mines Report of Investigations* 3107, May 1931, 7 pages.

The use of Mn-Si alloys which may be produced from domestic Mn ores for deoxidation, would decrease the ferro-Mn requirements of a very large tonnage of our steel by 60–80% and in some cases 100%. The open hearth heats made with these alloys have been of excellent quality. The tonnage of ferro-grade ores made available by the Bureau of Mines' ore dressing studies, combined with the products resulting from such processes as those developed by the Bureau of Mines and by Bradley for Cuyuna ores, should easily fill our reduced ferro-Mn requirements when Mn-Si alloys and ordinary spiegel are used in the way described in this report, thus making the country independent of foreign ores. AHE(31)

The Wälz Process. I. Metal Volatilization as a New Assistant Process for the Treatment of Complex Copper-Zinc-Lead Ores. William E. Harris. *Canadian Mining Journal*, Vol. 52, May 22, 1931, pages 525–529; **II. Features of a Wälz Plant, and Its Application to the Copper-Zinc-Lead Ores of Eastern Canada.** May 29, 1931, pages 546–550.

A discussion of the sale and treatment of the concentrates. The Wälz process is carried out in a rotary kiln with a mixture of raw concentrate and solid fuel, the latter serving for reducing purposes. Lead and zinc are freed from the oxide or sulphide compounds and volatilized. An oxidizing atmosphere is maintained above the charge in the kiln so that escaping metallic vapors and the carbon monoxide are burned right above the feed. The essential feature of the process is the fact that the zones where the reducing reactions are taking place are superimposed over the whole length of the reaction zone. The Follsain process is another volatilization process, recently brought forward and carried out in a rotary kiln. It is similar to the Wälz process except in the fact that reaction air preheated to 600–800° C. is added to the process instead of cold air. II. A longitudinal section and cross section shows the simplicity of a Wälz plant. It consists of 3 main sections: the crushing, proportioning, mixing and feeding apparatus; the rotary kiln itself with incidental heating appliances; and the gas main with equipment for precipitating the oxide. For precipitating the oxides, Cottrell plants as well as the usual bag houses have given good results. Some existing plants are treating materials in the form of a slurry. For uniform working close observation is necessary on the temperatures at the different points in the kiln. Application of the process by the Base Metal Extraction Co. on a mixed copper-zinc concentrate from an Eastern mine yielded a sinter containing only 54% Zn (96% recovery). The following claims are made for the process: (1) it permits the treatment of mixed copper-zinc concentrates; (2) it eliminates the difficulties resulting in the formation of "insolubles" in roasting and reduces the roasting to the simple elimination of sulphur; (3) it recovers the precious metals with the copper where they are paid for; (4) it reduces the cost of subelectrolytic treatment of the zinc fume and (5) it appears to be the only volatilization process that has stood the test of commercial application. Flowsheets for the treatment of Zn-Cu-Pb concentrate with volatilization as an auxiliary process as well as the main primary process are shown. WHB(31)

Compendium of Metallurgy. (Precis de metallurgie.) H. Pécheux. J. B. Bailliere et Fils, Paris, 1931. Paper, $4^3/_4 \times 7^1/_2$ inches, 650 pages. 4th edition. Price 35 Fr.

A general survey of fire and electric smelting of metals. It is printed on a very poor paper and the 167 illustrations are either like old wood cuts or, as in the case of the few photomicrographs, badly blurred.

There is nothing especially complete or up-to-date in it, even if it is a new edition. Apparatus for determination of carbon in steel by wet combustion in chromic acid is illustrated, and the Cowles electric furnace for making aluminum bronze is shown as if these were in metallurgical use today.

This comes close to being the poorest excuse for a book on any branch of metallurgy we have ever seen.—H. W. Gillett (31)-B-

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Some Developments in the Use of Zinc Pigments. H. A. Nelson (New Jersey Zinc Company). *American Metal Market*, Vol. 38, Apr. 22, 1931, pages 5, 10.

Presented at Annual Convention American Zinc Institute, April 1931. Covers entire field of uses for Zn pigments. DTR(32)

Tunnel Furnace for Enameling. C. B. Phillips. (Surface Combustion Co.). *Iron Age*, Vol. 126, July 17, 1930, pages 159–161.

Discusses vitreous enameling as practiced by the American Stove Co. Vitreous enameling includes dipping, spraying, drying and burning. The necessary units were built by the Surface Combustion Co. The furnace is 120 ft. long, the conveyor units are 187 ft. overall and the furnace is divided into 2 heating chambers. Each section is divided into heat interchange, preheat, heating, heat interchange and cooling. Sheet steel after pickling and dipping in ground coat enamel is burned on at 1600° to 1800° F. and the white coat at 1400° to 1600° F. Firing is done by gas burners. The installation has reduced labor and fuel costs, eliminated separate drying process and cut percentage of rejects. VSP(32)

Coating with Sound-Damping Materials and Rust Removing Agents (Das Auftragen schalldämpfender Materialien und Entrostungsmittel.) A. H. Feige. *Automobiltechnische Zeitschrift*, Vol. 34, June 10, 1931, pages 382–383.

The all-steel bodies for automobiles which have recently come into use have the disadvantage of beginning to vibrate badly after a certain speed is reached and in resonance with vibrations of motor, unevennesses of road, etc. This may be eliminated if a very viscous asphalt lacquer or tar-oil product, sometimes mixed with sawdust, is sprayed on. This spraying may include the whole inner surface, or only parts of it, or even just the corners. The viscous liquid can be sprayed on without heating under a pressure of 4 atmospheres with spraying guns having nozzles of at least 3 mm. diameter under 4 to 5 atmospheres air pressure. Spots of rust can be removed by spraying with a de-rusting agent such as deoxidine with ordinary spraying apparatus. The correct treatment of parts and the required procedure are described. Ha(32)

Method of Preparing Sheet Metal for Finishing. H. M. Hagy (Wanger Elevator Mfg. Co.). *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, page 802.

First all rust spots and scratches are sanded with No. $2^1/_2$ emery cloth. The metal is washed with gasoline, benzine or naphtha. If a composition molding is present, it is washed with a solution of 2 pt. vinegar and 1 pt. H_2O. Scratches, pits and welding spots are then filled up with a paste of dry white Pb and shellac, which, after drying, is sanded down to the metal surface. After wiping clean, a thin coat of an oxide primer is applied, baked at 350° F. for 2 hr. and then sanded with No. 000 sandpaper. MS(32)

Choice of Pigments for Anti-Rust Paint Coatings. (Zur Wahl der Pigmente für Rostschutzfarben.) J. Schneider. *Korrosion und Metallschutz*, Vol 7, Mar. 1931, pages 60–61.

Review of the present state of non-metallic coating technique. EF(32)

Ramet Toolpak

The Ramet Toolpak consists of five small but sturdy Ramet tipped tools, a rugged tool holder and a special grinding wheel, all packed in a finely finished wooden case.

Heretofore the advantages and economies of Ramet tools have been available only to large production plants because of the great cost of special tool designs. The Ramet Toolpak overcomes this limitation by providing a number of inexpensive Ramet tool bits of various shapes to handle a wide variety of work.

An important innovation in these Ramet tool bits is the use of shanks made of a special metal having practically the same coefficient of expansion as Ramet. This metal was developed by Dr. C. W. Balke, Director of Research, Ramet Corporation of America, North Chicago, Ill., and overcomes many of the difficulties encountered in the use of steel shanks because the Ramet tip is not under strain. This special metal also has great advantages in the manufacture of large Ramet tools, especially those having tips of unusual size or shape.

Two right hand, one left hand, one round nosed and one grooving tool contained in the Ramet Toolpak adapt it to the varied jobs of ordinary shops.

In order that longer tool life will be had, a tool holder specially designed to give the proper support and top rake is included in the set.

Ramet tools should be ground on suitable wheels in order to get a keen cutting edge and to minimize the amount of metal removed in sharpening. A special grinding wheel which will fit practically all bench grinders is furnished with the Toolpak so that the Toolpak is complete in every detail.

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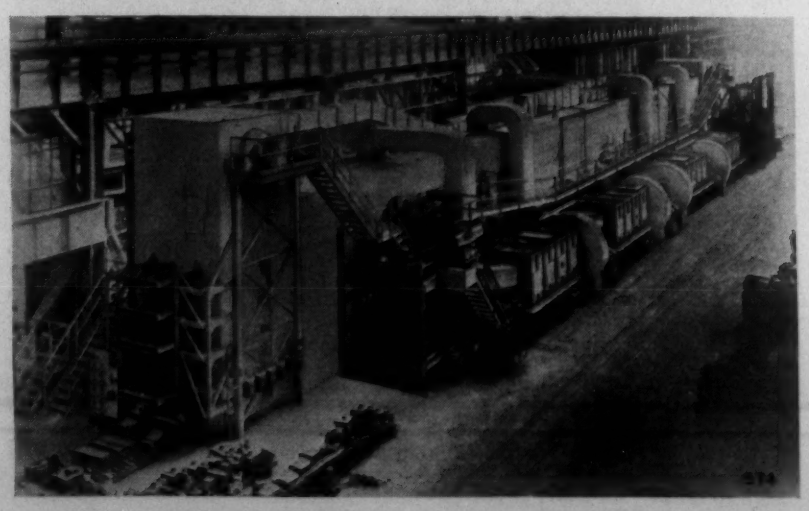
New Core Oven

The world's largest core oven with a capacity of 800 tons of cores per day, built by the Foundry Equipment Company, Cleveland, Ohio, uses the roller conveyor system, permitting the handling of heavy cores with a minimum of core plate thickness and weight, core breakage practically eliminated and waste oven volume reduced to a minimum.

Approximate dimensions are 235 feet long, 11 feet wide and 20 feet high. The oven contains five tiers or passes each provided with roller conveyors designed for high temperature operation. Lighter core plates are used as the roller conveyor provides practically a continuous support regardless of size. Core plates are moved through the oven by means of pusher mechanism operating directly on the plates. Each tier has a variable speed transmission so that the baking time can be varied as desired.

The oven is heated with four large quadruple heaters located outside of the oven. They are oil fired and automatically controlled. The hot gases from the heaters are delivered to the main oven chamber through a series of ducts. Part of the gases are exhausted from the oven, but the great portion are returned to the heaters to help in the diffusion of the hot gases from the combustion chambers and are then recirculated.



A unique loading and unloading arrangement is incorporated. The cores move on roller conveyors from the core making stations to the loading end of the oven. The lower tiers of the oven are served by a pneumatic elevator, while the cores which go to the three upper tiers are raised by means of an inclined elevator having an automatic locking device to assure perfect alignment of the core plates as they pass from the elevator to the oven rollers.

At the unloading end, the cores are lowered to the floor level by means of an elevator. As the elevator reaches floor level cores are automatically ejected from the oven. The entire system interlocks and is automatically controlled.

PATENT DEPARTMENT

An arrangement with Mr. W. M. Corse, Metallurgical Engineer, Washington, D. C., who operates an Engineering Information Service, enables us to publish a list of important patents from the United States, Canada, England, Germany, France, Switzerland, Denmark, Holland, Sweden, Norway and Italy.

Copies of patents and translations will be supplied at reasonable cost. Patent searches made at minimum rates. Estimates cheerfully given.

Information about this service may be secured by writing to the Patent Department, METALS & ALLOYS, 810 Eighteenth Street, Washington, D. C.

United States Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Note: Numbers of Reissue Patents are preceded by "Re."

Process of finishing cadmium plated goods. C. A. Ganser, 1,816,837, 3/14/30.

Process for refining ores or products containing aluminum oxide. T. R. Haglund, 1,816,842, 5/18/25; in Sweden 6/2/24.

Metal pickling process. G. L. Magoun, *et al.*, 1,816,860, 11/6/30.

Welding method and apparatus. T. E. Murray, 1,816,864, 5/29/29.

Chaplet. C. H. Reeder, 1,816,870, 6/3/29.

Electrolytic device. H. O. Siegmund, 1,816,875, 4/27/27 (with film-forming electrodes).

Process of cleaning wire. C. J. Warnke, 1,816,881, 3/10/30.

Annealing pot. C. A. Finn, 1,816,930, 7/8/30.

Self feeding swaging roll. E. W. Stoler, 1,816,940, 3/8/29.

Alloy and method of preparing same. (*Ag-Be.*) H. S. Cooper, 1,816,961, 12/2/25.

Manufacture and purification of magnesium. A. Jessup, 1,816,972, 4/2/26; in France 10/9/25.

Process of forging magnesium alloys. G. Michel, 1,816,983, 3/24/28; in France 3/31/27.

Process and machine for centrifugally extruding and casting substances. J. Merle, 1,817,012, 9/4/26.

Method and machine for rolling wheel disks. J. W. Hughes, 1,817,035, 11/20/26.

Converter smelting. H. H. Stout, *et al.*, 1,817,043, 4/8/27.

Treatment of zinciferous materials containing cadmium. H. M. Cyr, *et al.*, 1,817,068, 10/15/29.

Electric welding process. O. L. Mills, 1,817,092, 11/9/28.

Apparatus for galvanizing wire and the like. H. G. Black, 1,817,122, 4/22/29.

Method of open annealing sheet metal. A. T. Kahner, 1,817,152, 7/19/29.

Article and method of making the same. (*Zn coated.*) C. S. Brock, 1,817,174, 8/19/27.

Wheel welding machine. J. W. Hughes, 1,817,193, 1/30/28.

Pipe upsetting machine. J. H. Taylor, 1,817,215, 11/25/21.

Control means for hot blast stoves. F. H. Wilcox, *et al.*, 1,817,219, 8/13/27.

Welded rail joint construction. V. C. Armstrong, 1,817,225, 2/24/31.

Coating for metal casting molds and cores. M. L. Freed, 1,817,245, 5/10/30.

Extrusion of metal pipes and the like. P. Dunsheath, 1,817,301, 6/26/30; in Great Britain 7/1/29.

Method and means for the obtainment of decorative effects upon textile fabrics by brilliant metallic deposits. M. C. R. Hedde, 1,817,311, 1/24/30; in France 6/19/29.

Casting apparatus. T. B. Barr, 1,817,340, 8/3/29.

Process for case carburizing and heat treating metals. P. V. Brower, 1,817,345, 7/19/27; 1,817,407, 7/19/27.

Testing machine. (*Hardness testing.*) L. M. Showers, 1,817,170, 12/16/29.

Method and apparatus for casting journal boxes. L. W. Melcher, 1,817,388, 2/16/29.

Casting machine. L. C. Goad, *et al.*, 1,817,483, 10/12/29.

Treating metals and compositions therefor. J. C. Vignos, 1,817,500, 1/14/28.

Electrolytic separation of copper. M. Schlotter, 1,817,527, 9/28/29; in Germany 10/29/28.

Shake-out apparatus. V. J. Davis, 1,817,613, 2/17/28.

Die of the extruding and wire drawing type and process of making the same. J. T. Pratt, *et al.*, 1,817,680, 11/28/25.

Apparatus for producing low carbon iron. I. R. Valentine, 1,817,784, 11/-28/28.

Metallurgy of ores or materials containing tin. E. A. Ashcroft, 1,817,865, 5/7/28; in Great Britain 4/5/28.

Protective coating. (*Alborizing.*) R. E. Lowe, 1,817,888, 11/27/29.

Pyrometallurgical copper refining. H. H. Stout, 1,817,935, 8/15/28.

Manufacturing process. (*Tinning inside of Cu tubing.*) C. C. Ritter, *et al.*, 1,818,008, 11/27/29.

Magnetic material. (*Fe-Ni-Si.*) G. W. Elmen, 1,818,054, 1/12/27.

High frequency coil for electric induction furnaces. G. E. Taylor, 1,818,107, 7/5/28; in Great Britain 12/7/27.

Apparatus for the fusion electrolysis of metallic chlorides. R. Suchy, *et al.*, 1,818,173, 12/15/28; in Germany 12/23/27.

Partition for separating the products of fusion electrolysis of metallic chlorides. R. Suchy, *et al.*, 1,818,174, 2/11/30; in Germany 12/23/27.

Electroplating. L. R. Westbrook, 1,818,179, 2/23/28.

Method of coating substances. (*With alkali and alkaline-earth metals.*) H. S. Cooper, *et al.*, 1,818,196, 9/20/27.

Metal treating apparatus. C. Schumacher, 1,817,902, 1/16/30 (Original 3/3/27).

Electroplating. G. Lutz, *et al.*, 1,818,229, 2/23/28.

Ingot mold. T. McNally, 1,818,236, 3/18/27.

Electric furnace. W. E. Moore, 1,818,239, 9/25/29.

Device for annealing metal rings. F. Linnhoff, 1,818,341, 11/18/29; in Germany 11/24/28.

Process for the manufacture of metallic sheets. J. R. Cain, *et al.*, 1,818,379, 12/2/27.

Quenching oils. H. Rodman, 1,818,431, 5/16/29.

Method for the purification of iron and steel. M. Jaeger, *et al.*, 1,818,556, 12/13/28; in Germany 12/17/27.

Welding apparatus. J. A. Baker, 1,818,665, 5/23/27.

Molding apparatus. A. T. Bateman, *et al.*, 1,818,667, 7/30/28.

Furnace. J. F. Schrumn, 1,818,759, 5/8/30.

Zinc alloy. L. E. Wemple, *et al.*, 1,818,774, 1/21/31.

Electric furnace. H. G. Campbell, 1,818,789, 10/9/29; in Great Britain 5/15/29.

Electric furnace. A. Musso, 1,818,812, 3/14/28.

Method of recovering gold and silver. S. W. Giles, 1,818,846, 11/22/29.

Method of forming a compromise rail joint bar. D. L. Braine, 1,818,880, 6/5/29.

Process for preparing acid-proof cementing or lining compositions. K. Frank, *et al.*, 1,818,888, 9/8/26; in Germany 9/18/25.

Refractory article and composition for and method of making same. R. H. Martin, 1,818,903, 7/31/25.

Silicon carbide refractory article and method of making the same. R. H. Martin, 1,818,904, 4/18/25; this filed 7/22/27.

Process for precipitating rhodium, iridium, osmium, ruthenium, and the like. E. H. Reerink, 1,818,909, 5/14/28; in the Netherlands 10/20/27.

Soldering pot. R. E. Brown, 1,818,925, 12/2/29.

Mixer for welding torches. G. L. Hammon, 1,818,949, 4/6/29.

Method of producing substantially pure metallic magnesium directly by electrolysis of a fused bath. R. M. Hunter, 1,820,022, 5/31/29.

Furnace. C. L. Norton, 1,820,028, 2/8/29.

Electric welding machine. W. R. Hume, 1,820,139, 5/16/28; in Australia 5/21/27.

Process for the purification of metals. A. C. Jessup, 1,820,141, 10/23/28; in France 11/7/27.

Method of producing puddled iron ingots. A. H. Beale, 1,820,175, 7/19/28.

Method of granulating steel and forming wrought iron. A. H. Beale, *et al.*, 1,820,176, 7/19/28.

Manufacture of wrought iron from Bessemer steel. J. Aston, *et al.*, 1,820,177, 7/19/28.

Method of preparing and remelting synthetic slags. A. H. Beale, *et al.*, 1,820,178, 7/21/28.

Method of preparing or remelting wrought iron slag. E. L. Ives, 1,820,179, 7/21/28.

Forging machine. F. A. Halleck, 1,820,188, 7/30/20; this filed 9/9/24.

Furnace heat exchange apparatus. R. S. Riley, 1,820,199, 8/10/25.

Forging machine. W. H. Wineman, 1,820,207, 10/28/25.

Forging machine. W. H. Wineman, 1,820,208, 1/4/28.

Optical pyrometer. D. C. Gall, 1,820,219, 6/23/28; in Great Britain 6/-29/27.

Molding machine. H. B. Swan, 1,820,405, 11/16/29.

Treatment of zinc-bearing material. W. C. Hooey, 1,820,455, 2/7/29.

Fissure detector for metals. E. A. Sperry, 1,820,505, 8/10/28.

Apparatus for cooling and annealing metal bars. J. R. George, Re 18,152 (original 1,642,437, 9/13/27), 2/19/31.

Front wall for open hearth furnaces. H. Rateau, *et al.*, 1,819,001, 1/16/31.

Air and water cooled furnace and generator block. G. W. Davey, 1,819,016, 12/29/25.

Valve aggregate for regenerative furnaces, heat apparatus, etc. E. S. S. Wohlfahrt, 1,819,052, 10/30/29; in Sweden 9/19/29.

Operation of blast furnaces. E. Baumgartner, 1,819,064, 2/7/30; in Germany 2/11/29.

Electroplating and electroplating apparatus. J. A. Smith, 1,819,130, 4/19/26.

Method of producing pyrophoric iron. H. L. Hartenstein, 1,819,164, 10/-18/26.

Electric process of reducing ores. A. E. Greene, 1,819,238, 7/17/24.

Electric smelting apparatus. A. E. Greene, 1,819,239, 6/1/25.

Art of extruding cold materials. (*Metals.*) J. G. C. Mantle, 1,819,254, 3/31/24.

Mandrel for tube rolling mills. P. Multhaupt, 1,819,257, 8/10/29; in Germany 11/26/28.

Bearing. (*Welded-on porous lining.*) C. R. Short, 1,819,272, 9/22/27.

Method of assembling structural steel. (*By welding.*) A. A. Goerz, 1,819,287, 12/1/28.

Method of annealing sheet copper. G. A. Hempstead, 1,819,291, 1/30/30.

Hot top. L. G. Firth, *et al.*, 1,819,364, 9/24/29.

Mold. L. G. Firth, 1,819,365, 11/2/29.

Tube swaging machine and method. F. Müller, 1,819,376, 8/25/24.

Apparatus for roasting ores. H. H. Nicholson, 1,819,436, 7/30/29.

Method of making silicon iron compounds. J. A. Parsons, 1,819,479, 1/23/30.

Counterflow carburizing machine. H. H. Harris, 1,819,509, 3/15/29.

Resistor and terminal connection. A. J. Hanson, 1,819,554, 11/9/27.

Electroplating apparatus. J. W. Hughes, 1,819,603, 9/21/28.

Method of treating waste alloys for the purpose of removing therefrom certain constituents whose presence renders the alloys unsuitable for certain uses. P. Kemp, 1,819,607, 6/23/28; in Austria 6/23/27.

Ring forming machine with knockout. C. L. Wiles, 1,819,630, 2/2/28.

Shearing metal plates. J. J. Cain, 1,819,636, 4/6/28.

Electric soldering iron. J. Buccola, 1,819,671, 5/16/30.

Ingot mold. E. Gathmann, 1,819,705, 2/5/31.

Process for composite casting. I. Sugimura, *et al.*, 1,819,722, 11/22/29.

Continuous sheet metal. W. M. Blecker, 1,819,763, 6/23/28.

Continuous strip metal. W. M. Blecker, 1,819,764, 6/23/28.

Chill for castings. G. C. Bumbaugh, 1,819,765, 5/4/28.

Process for decomposing ores of the rare earths, of zirconium and titanium, in a cycle by means of sulphuric acid. J. D'Ans, 1,819,770, 5/12/28; in Germany 5/23/27.

Process of applying heat. W. A. Darrah, 1,819,772, 10/12/29.

Method of casting continuous polygonal bands. W. M. Carty, 1,819,942, 2/20/29.

Method for manufacturing ingots. Z. Colwell, 1,820,597, 3/7/30.

Manipulator for rolling mills. A. T. Keller, 1,820,622, 2/8/30.

Electrode for electric furnaces. P. L. J. Miguet, 1,820,625, 6/23/28; in France 3/31/28.

Means and method of forming and feeding weldrods. H. J. Burnish, 1,820,649, 5/8/30.

Process of obtaining beryllium compounds from beryllium-bearing minerals. H. Fischer, 1,820,655, 12/13/28; in Germany 12/15/27.

Foundry tool. A. A. Meyer, 1,820,819, 4/25/29.

Apparatus for obtaining light metals by electrolysis. E. Steinbuch, *et al.*, 1,820,844, 10/14/29; in Switzerland 8/23/29.

Apparatus for the dipping of tubes or rods for pickling, etc. H. Trevorrow, 1,820,851, 4/29/29; in Great Birtain 5/10/28.

Heat treating furnace. H. O. Breaker, 1,820,879, 3/3/28.

Manufacture of potassium. W. Busch, *et al.*, 1,818,881, 7/21/28; in Germany 8/5/27.

Method of reforming bars. G. Langford, Re 18,165 (original 1,712,506, 7/16/26), 7/6/31.

Austrian Patents

Subject of Invention, Patentee, Patent No. and Date of Beginning of Term of Patent.

Process for producing high-strength cast iron. Meier & Weichelt, 123,363, 2/15/31.

Process for bright-annealing metals. Siemens-Schuckertwerke G. m. b. H., 123,238, 12/15/29.

Process for deoxidizing ingot iron. The Armco International Corp., 123,364, 2/15/31.

Process for making ingot iron which is particularly suitable for enameling. Same patentee, 123,368, 2/15/31.

Process for making steel by carburizing pure molten iron. H. J. van Royen, 123,369, 2/15/31.

Process for refining iron and steel baths. I. G. Farbenindustrie Akt.-Ges., 123,376, 2/15/31.

Lead-base bearing metal containing alkali and alkaline-earth metals, magnesium and aluminum, and process for making the same. W. Mathesius, *et al.*, 123,366, 2/15/31.

Process for making alloys containing aluminum and silicon but practically no titanium and iron, out of titanium- and iron-bearing raw materials containing alumina and silica. Metallges. Akt.-Ges., 123,388, 2/15/31.

Refractory block for supporting heating wires. Siemens-Schuckertwerke G. m. b. H., 123,367, 2/15/31.

Device for connecting quadrangular carbon electrodes, particularly those of electric furnaces. Siemens Planiawerke Akt.-Ges. für Kohlefabrikate, 123,387, 2/15/31.

Process for butt-welding two-piece hollow bodies. Budd-Wheel Co., 123,359, 2/15/31.

Mechanical extrusion press for making metal pipes. Testa G. m. b. H., 123,-654, 5/15/29.

Device for automatically disconnecting the drive of pulling drums of wire-drawing benches. C. Rasch, 123,769, 3/15/31.

Wire coiling device. O. Stern, *et al.*, 123,780, 3/15/31.

Process for making solid or hollow ingots by centrifugal casting. Mannesmannröhren-Werke, 123,839, 3/15/31.

Apparatus for examining crystalline bodies with the aid of X-rays. N. V. Philips' Gloeilampenfabrieken, 124,017, 3/15/31.

Checkerwork for the regenerators of melting furnaces and the like. "Feuerungstechnik" Spezialbauunternehmung G. m. b. H., 123,855, 3/15/31.

Trough-shaped tilting vessel for pouring molten metal, particularly iron. K. Rein, 123,886, 3/15/31.

Motor piston made of aluminum containing over 20% silicon. K. Schmidt G. m. b. H., 123,888, 3/15/31.

Casting machine actuated by pressure of a piston. J. Polák, 123,899, 3/15/31.

Centrifugal casting process and mold for making thin annular castings. W. Bremicker, 123,900, 3/15/31.

Process for making aluminum and aluminum alloys out of pre-alloys. T. R. Haglund, 123,814, 3/15/31.

Process for removing suspended particles of iron and similar impurities from magnesium and high-percentage magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 123,808, 3/15/31.

Process for increasing the corrosion-resistance of hot-worked objects made of magnesium containing 0.5–2.5% manganese. Same patentee, 123,818, 3/15/31.

Process for making shaped objects. F. Krupp Akt.-Ges., 124,079, 11/15/30.

High-frequency induction furnace. Oesterreichische Siemens-Schuckertwerke, 123,843 (Addition to 119,737), 3/15/31.

Process for making non-passive nickel electrodes. The International Nickel Co., Inc., 123,835, 3/15/31.

Process for coating metal conductors (preferably strip or wire) with a hydroxide-oxide mixture, the metal of which is different from the conductor metal. F. Hansgirg, 124,070, 4/15/30.

Welding flux containing potassium and lithium, for welding magnesium and its alloys. I. G. Farbenindustrie Akt.-Ges., 123,796, 3/15/31.

Process for cleaning metal surfaces. J. H. Gravell, 123,803, 3/15/31.

Process for metallizing objects of organic origin in a high vacuum. K. Richter, 123,816, 3/15/31.

Process for making sulphonation productions for use as inhibitors in metal-pickling baths, especially those for iron and steel. V. Bertleff, 123,823, 3/15/31.

Process for protecting metallic coatings on iron and steel during the plating process. Copperized Steel, Ltd., 123,824, 3/15/31.

Process and apparatus for the continuous surface- and heat-treatment of metals in the form of strip. Same patentee, 123,825, 3/15/31.

Process for making a lead solder. American Machine & Foundry Co., 123,827, 3/15/31.

Process and solder for soldering tungsten and molybdenum. N. V. Philips' Gloeilampenfabrieken, 123,828, 3/15/31.

Process and material for soldering and welding chains, rings, jewelry and the like. J. Brunhübner, 123,829, 3/15/31.

Process for making pickling baths for iron and steel, containing water-soluble sulphonation products. V. Bertleff, 123,832, 3/15/31.

Process for making a stable foam, particularly on acid pickling baths. J. H. Gravell, 123,833, 3/15/31.

Device particularly for guiding the burners of cutting or welding machines by a template. A. Schmidt, 123,766, 3/15/31.

Process and apparatus for welding two-piece hollow bodies. Budd Wheel Co., 123,776, 3/15/31.

Process for making polygonal containers, particularly out of rustless steel, especially for ice cells and the like. F. Krupp Akt.-Ges., 123,785, 3/15/31.

Process for plating metals with aluminum or aluminum alloys. Vereinigte Silberhammerwerke Ketze & Co., 123,770, 3/15/31.

British Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Note: When the date applied for differs from the date on which the application was lodged at the British Patent Office, the former date is given, followed by *.

Detection of cracks in iron or steel parts by magnetic means. W. L. Lorkin, *et al.*, 351,767, 7/16/30.

Process for manufacturing steel rims and hoops used in wheels and hubs. A. Dechenne, 351,779, 8/11/30.

Gold alloy particularly suitable for jewelry. Cartier, 351,811, 7/14/30*.

Salt bath furnaces for the heat treatment of steel and other metals. Siemens-Schuckertwerke Akt.-Ges., 351,812, 9/19/29*.

Method for the manufacture of tube welding bells. J. Mark, 351,840, 9/24/30.

Heat recuperating structures. H. De Gaillard et Cie., 351,863, 10/17/29*.

Regulation of electric arc soldering machines. British Thomson-Houston Co., Ltd., 351,883, 11/16/29*.

Oxy-arc cutting tools. Same patentee, 351,895, 1/9/30*.

Joining zinc-aluminum alloys to steel. H. C. Hall, 351,977, 1/25/30.

Reducing zinciferous materials containing lead and other contaminating metals. The New Jersey Zinc Co., 352,005, 2/3/30; 353,371, 12/30/29.*

Metal rolling. J. B. Tytus, 352,047, 3/21/30.

Magnetic materials. Electric Research Products, Inc., 352,019, 4/2/29.*

Annealing pots and the like. E. L. James, 352,061, 4/2/30.

Control of electric generators for arc welding. J. H. Holmes & Co., Ltd., 352,-066, 4/4/30.

Welding electrodes and coatings therefor. Hollup Corp., 352,086, 4/5/30.

Cathodes for the electrolytic refining of metals. United States Metals Refining Co., 352,104, 4/9/30.

Heat treatment furnaces. Hevi Duty Electric Co., 352,174, 5/22/29.*

Refining aluminum, magnesium and their alloys. H. C. Hall, 352,199, 6/5/30.

Rust proofing of iron, steel and other metals. W. H. Cole, 352,202, 6/10/30.

Method of electric welding. R. D. Malm, 352,223, 6/24/30.

High-strength grey cast irons, and methods of producing same. International Nickel Co., Inc., 352,510, 1/5/29.*

Process for the manufacture of copper wire. S. O. Cowper-Coles, 352,385, 1/7/30.

Electrically driven roller-way conveyers. F. Krupp Grusonwerk A.-G., 352,-402, 5/29/29.*

Means for preheating the air supply to furnaces. H. A. S. Gothard, *et al.*, 352,405, 4/4/30.

Process of and apparatus for the manufacture of hollow bodies, especially tubes, by drawing over a mandrel. Metallges. A.-G., *et al.*, 352,505, 4/10/30.

Electric upsetting and forging machines. G. Benedetto, 352,508, 4/10/30.

Manufacture of material suitable for resisting rifle bullets and other projectiles, and for other purposes. R. A. Hadfield, 352,548, 4/12/30.

Presses for working sheet metal and the like. Marquette Tool & Mfg. Co., 352,559, 4/16/30.

Method of reducing ores with gases. F. M. Wiberg, 352,580, 7/6/30.*

Expanded-metal and other sheets, and processes for manufacturing such sheets. M. Kaminetsky, 352,584, 4/23/30.

Processes and apparatus for the cooling of annealed goods in cooled vessels. H. Prüfert, 352,586, 4/24/30.

Pressure die-casting machine. Armstrong, Whitworth & Co., Ltd., *et al.*, 352,600, 5/1/30.

Process for the manufacture of hollow profile sections from sheet metal. M. Gessner, 352,614, 5/6/30.

Copper-silicon-zinc alloys. Hirsch, Kupfer-und Messingwerke A.-G., 352,639, 2/13/30*.

Method for the production of oxidic coatings on articles made from aluminum and its alloys. R. E. Muller, 352,656, 5/24/29*.

Process of purifying or refining non-ferrous metals and alloys. D. R. Tullis, *et al.*, 352,671, 6/4/30.

Method of annealing or other heat-treatment of metals, more especially iron and steel. N. G. Elfstrom, 352,677, 6/10/30.

Sheaths of electric cables and pipes of lead and lead alloys. Callender's Cable & Construction Co., Ltd., *et al.*, 352,700, 6/21/30.

Method for welding steel parts. L. C. Delachaux, 352,714, 7/27/29*.

Apparatus for autogenous cutting and welding under water. H. Topper, 352,-749, 7/30/29*.

Metal alloys. C. Vangrevenynge, et *al.*, 352,759, 1/7/30*.

Manufacture of seamless lead pipes, in particular cable sheaths. Siemens-Schuckertwerke A.-G., 352,797, 12/3/29*.

Steel mold and the method of manufacturing the same. United States Pipe & Foundry Co., 352,824, 2/4/30*.

Agglomeration of finely divided ferruginous ores, concentrates, and the like. A. Folliet, *et al.*, 352,832, 10/30/29*.

Manufacture of tubes. Vereinigte Stahlwerke A.-G., 352,868, 2/8/30*.

Method of bundling rod-shaped material, particularly metal rods or tubes. Hirsch, Kupfer-und Messingwerke A.-G., 352,875, 11/27/29*.

Manufacture of refractory products from magnesium silicates. Metallges. A.-G., *et al.*, 352,881, 7/7/30*.

Metal-rolling mills. F. Möller, 352,889, 1/2/30*.

Electrical welding-machines. Vereinigte Stahlwerke A.-G., 352,895, 2/7/30*.

Iron-titanium alloys. W. Kroll, 352,964, 2/16/29*.

Method of and apparatus for shaping metal from a hollow blank. Bridgeport Brass Co., 353,040, 3/18/30.

Cobalt high-speed tool steel. Oesterreichische Schmidt-Stahlwerke A.-G., 352,951, 4/14/30.

Method of operating furnaces for brazing, annealing and the like. British Thomson-Houston Co., Ltd., 353,062, 4/19/29*.

Manufacture of sponge iron. I. Rennerfelt, *et al.*, 353,180, 6/12/30.

Method and apparatus for casting copper or equivalent copper alloys. American Metal Co., Ltd., *et al.*, 353,205, 6/24/30.

Process of treating metallurgical slimes. Metallges. A.-G., 353,212, 6/28/29*.

Metal strip or sheet rolling processes and apparatus. Morgan Construction Co., 353,224, 7/4/30.

Fin tubing for heat-exchange apparatus and method of making the same. Griscom-Russell Co., 353,251, 8/1/29*.

Manufacture of welded articles. H. Schmuckler, 353,254, 5/21/30.

Electric induction furnaces. Associated Electrical Industries, Ltd., 353,270, 8/14/29*.

Cooling-boxes for metallurgical furnaces. J. H. Ledeboer, 353,298, 8/29/30.

Drawing and winding drum for multiple-pass wire-drawing machines. W. Nacken, 353,326, 10/3/30.

Devices for suspending articles in electric-plating baths. Langbein-Pfanhauser-Werke A.-G., 353,332, 11/30/29*.

Receiving-apparatus for goods in bulk to be galvanically coated. Siemens & Halske A.-G., 353,337, 10/18/29*.

Methods of reclaiming and reusing metallic-scrap mixtures. Ford Motor Co., Ltd., 353,377, 2/4/30*.

Iron, chromium, and nickel alloys. International Nickel Co., 353,448, 1/22/29*, and 353,459, 1/22/29*.

Armour-piercing projectiles. R. A. Hadfield, *et al.*, 353,425, 1/22/30.

Method of producing ferro-chrome. K. M. Simpson, 353,406, 10/9/29*.

Method of cleaning the surface of metals. Bullard Co., 353,488, 3/21/30.

Preventing corrosion of metallic surfaces. H. Sutton, *et al.*, 353,415, 4/14/30.

Metal castings. E. A. Hailwood, 353,497, 4/22/30.

Method of producing covered weld-rods for electric arc welding, and weld-rods produced thereby. A. F. Burgess, 353,499, 4/22/30.

Device for casting bearings. R. Fuche, 353,530, 4/30/30.

Foundry molding-machine. A. Baillot, 353,545, 3/4/30*.

Apparatus for measuring the hardness of materials. A. F. Shore, 353,549, 5/5/30.

Welding. I. G. Farbenindustrie A.-G., 353,671, 7/12/30.

System of construction of suspended furnace roofs. E. Strunk, *et al.*, 353,682, 7/17/30.

Machines for testing the hardness of materials. W. & T. Avery, Ltd., *et al.*, 353,729, 8/21/30.

Methods of and machines for producing core boxes. A.-G. der Eisen & Stahlwerke vorm. G. Fischer of Schaffhausen, 353,734, 8/23/30.

Apparatus for testing steel-wire ropes. Smith, Major, & Stevens, Ltd., *et al.*, 353,743, 9/1/30.

Soldering-materials. General Electric Co., Ltd., 353,758, 9/28/29*.

Apparatus for sorting rods, tubes, or the like. British Thomson-Houston Co., Ltd., 353,785, 10/9/29*.

Boxes for packing tin-plates and for the like purposes. W. H. Bolt, 353,807, 11/20/30.

Production of metallic tungsten. I. G. Farbenindustrie A.-G., 353,815, 12/31/29*.

Production of metal stampings. Pressed Steel Co. of Great Britain, Ltd., *et al.*, 353,820, 12/23/30.

Manufacture of fusion-welded pipe. Air Reduction Co., Inc., 353,821, 1/8/30*.

Method and apparatus for machining rolls for rolling-mills and the like. Mannesmannröhren-Werke, 353,829, 2/15/30*.

Tube draw benches. Demag A.-G., 353,830, 2/20/30*.

Sintering-plants. H. Eriksson, 353,833, 3/27/30*.

Rolling metal. Cold Metal Process Co., 353,525, 1/11/30*.

Process for manufacturing aluminum alloys. S. Junghans, 353,891, 1/31/29*.

Two-step sulphatizing roasting process. F. A. Brinker, 353,861, 2/18/30.

Melting flux for purifying aluminum, its alloys, and other non-ferrous metals. F. Dubberley, *et al.*, 353,867, 3/26/30.

Protective masks for the use of welders. H. C. Greene, *et al.*, 354,019, 7/1/30.

Hard metal compositions. British Thomson-Houston Co., Ltd., 354,028, 7/16/29*.

Presses for drawing sheet metal and the like. F. J. Rode, 354,045, 7/29/30*.

Conversion of metallic ores. H. Edwards, *et al.*, 354,098, 9/13/30.

Manufacture of tools. F. Krupp A.-G., 354,112, 4/16/30*.

Alloys of palladium, silver, and copper. International Nickel Co., Inc., 354,216, 1/28/29*.

Electric furnaces. Carborundum Co., 354,172, 3/3/30.

Steel capable of resisting rust and corrosion. R. Kesselring, *et al.*, 354,177, 3/30/29*.

Sheet-feeding devices. E. G. Budd Mfg. Co., 354,223, 4/3/29*.

Method and means for lapping wire-drawing and other dies. W. Haddow, 354,225, 4/5/30.

Apparatus for forging and roughing-out iron and steel bars by electricity. Soc. Holding des Brevets et Procédés Giacchino pour l'Ebauchage Electrique, 354,188, 4/30/29*.

Machines for the pressure casting of metals. Armstrong, Whitworth & Co., *et al.*, 354,227, 5/1/30.

Feed rods for use in soldering, brazing, or welding. A. Stephenson, *et al.*, 354,195, 5/1/30.

Aluminium-copper-light metal alloys. O. Kamps, 354,202, 5/2/30.

Rolling-mills. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 354,234, 5/5/30.

Welding wire. G. Bammer, 354,261, 5/6/30.

Lead extrusion-presses. B. E. Marean, 354,365, 5/8/30.

Manufacture of chromium or alloys thereof. General Electric Co., Ltd., *et al.*, 354,387, 5/10/30.

Manufacture of tubes and the like. Brittania Tube Co., Ltd., *et al.*, 354,457, 8/2/30.

Moulds for producing hollow metal bodies by vertical centrifugal casting. H. Lent, *et al.*, 354,459, 8/5/30.

Manufacture and production of shaped articles from metal powders. I. G. Farbenindustrie Akt.-Ges., 354,562, 8/21/30.

Oxy-acetylene and like torches for welding or like purposes. Air Reduction Co., Inc., 354,599, 10/5/29*.

Manufacture of metal cutting and working and like tools. F. Krupp Akt.-Ges., 354,641, 11/21/29*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date

Electric furnace. P. L. J. Miguet, *et al.*, 313,347, 8/8/30.

Production of zinc. C. F. von Girsewald, *et al.*, 313,348, 11/7/28.

Lead refining method. P. W. Davis, 313,365, 4/22/30.

Method of producing zinc salt solutions. W. Kartenbeck, 313,388, 12/22/28.

Method of hardening internal surfaces. The American Manganese Steel Co., 313,429, 5/13/29.

Method of making copper weld tubing. The Bundy Tubing Co., 313,454, 10/18/29.

Acid inhibitor. The E. I. duPont de Nemours & Co., 313,474, 11/4/29.

Metallic paint. The Flintkote Co., 313,483, 4/24/30.

Method of roasting fine ores. The General Chemical Co., 313,486, 1/3/29.

Aluminum alloy. Metallges. Akt.-Ges., 313,506, 12/4/29.

Annealing apparatus. N. V. Mij. tot Beheer en Exploitatie van Octrooien, 313,509, 9/11/29.

Galvanizing or electroplating process. La Waldberg S. A., 313,558, 12/6/29.

Molding apparatus. V. J. Davis, 313,617 & 313,618, 6/7/29.

Method of recovering nickel from ores. F. L. Duffield, 313,621, 2/1/30.

Apparatus for converting molten metals into solid fabricated articles. H. Harris, 313,630, 1/29/31.

Process of treating pyrites. S. I. Levy, 313,647, 9/17/28.

Apparatus for treating molten slag. M. O. Sem, 313,685, 2/26/30.

Heat-resisting liquid metal for mending various metallic articles. M. Taradash, 313,693, 11/26/30.

Process for recovering cadmium from its compounds. The American Lurgi Corp., 313,712, 9/17/30.

Process of roasting and sintering pulverulent ores. The American Lurgi Corp., 313,713, 9/20/30.

Method of making brake drums. The Budd Wheel Co., 313,724, 1/20/30.

Electric heating furnace. The Geo. J. Hagan Co., 313,787, 10/30/30.

Constructional steel. F. Krupp Akt.-Ges., 313,797, 9/4/29.

Muffle furnace. F. Krupp Akt.-Ges., 313,798, 8/28/30.

Steel swage. (Nitrided.) The Nitralloy Ltd., 313,813, 2/20/29.

Apparatus for treating zinc. The St. Joseph Lead Co., 313,824, 12/9/29.

Process of treating sulphide ores. The Sulphide Corp., 313,826, 5/8/30.

Tubing die. The Titeflex Metal Hose Co., 313,832, 5/20/29.

Method of treating aluminum oxide minerals. L. M. Hughes, 313,855, 7/11/30.

Method of treating aluminum oxide. L. M. Hughes, 313,856, 7/11/30.

Finishing roll polisher. D. H. Williams, *et al.*, 313,865, 10/16/29.

Manufacture of metal billets or bars. F. W. Harbord, *et al.*, 313,873, 10/30/29.

Device for cutting holes. (Autogenous.) H. Greggersen, 313,903, 6/5/29.

Manufacture of magnesium and the alkaline earth metals by electrolysis. A. C. Jessup, 313,909, 7/5/26.

Method of metallizing articles of organic origin. K. Richter, 313,933, 8/1/30.

Method of thinly coating articles. K. Richter, 313,934, 8/1/30.

Electric furnace. A. Stansfield, 313,941, 1/3/30.

Non-corrosive alloy. The American Machine & Foundry Co., 313,951, 6/19/28.

Machine for bending metal sheets. The Cairns Development Corp., 313,931, 11/2/29.

Production of refractory articles. (Tungsten powder sintered to wool.) The Canadian Westinghouse Co., Ltd., 313,971, 12/15/23.

Method of producing uranium and uranium-zinc alloys. Same patentee, 313,973, 7/2/29.

Wire-bending die. Same patentee, 313,974, 3/26/30.

Lined bearing. The Cleveland Graphite Bronze Co., 313,981, 10/24/28.

Method of roasting finely divided sulphide ores. The General Chemical Co., 314,002, 1/3/29.

Apparatus for treating flux-core solder. The Kester Solder Co., 314,026, 10/13/30.

Apparatus for purifying zinc ores. The Matthiessen & Hegeler Zinc Co., 314,028, 5/17/30.

Welding method. The National Tube Co., 314,032, 10/6/30.

Apparatus for cooling wires in annealing furnaces. The Niagara Weaving Co., Ltd., 314,033, 7/5/30.

Method of preparing surfaces for coating. The Parker Rust-Proof Co., 314,035, 9/3/29.

Coated zinc product. Same patentee, 314,036, 9/30/29.

Method of making metallic magnesium. The Dow Chemical Co., 314,086, 5/4/25.

Danish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process and apparatus for welding two hollow pieces together. Budd Wheel Co., 44,206, 1/10/30.

Process and machine for rolling bulges and grooves. Vereinigte Stahlwerke Akt.-Ges., 44,222, 2/15/30.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Method of operating furnaces for melting ores, minerals and metals. Soc. Oxythermique, 708,581, 12/30/30.

Improved process for recovering and reutilizing mixtures of metal scrap. Ford Motor Co., Ltd., 709,107, 1/9/31.

Process for obtaining metals in pulverulent form. Vitriolfabrik Johannisthal Akt.-Ges., 709,124, 1/10/31.

Improvements to hard metal compositions and to processes for making them. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, Additions 38,878 & 38,897 (6th & 7th additions to 654,210 filed 4/4/28). 7/3/30 & 7/25/30.

Process and apparatus for making fusion-welded pipe. Air Reduction Co., 709,049, 1/6/31.

Permanent molds for casting metals, and processes for making them. J. B. Durand, 709,096, 1/9/31.

Improvements to electrodes for welding apparatus and machines. Ford Motor Co., Ltd., 709,106, 1/9/31.

Process for the electrolytic separation of copper. Asociaion de Productores de Yodo de Chile, 708,989, 10/1/29.

Process for the electrolytic separation of gold and silver. Same patentee, 708,990, 11/3/29.

Annealing furnace cooling chamber, containing a reducing atmosphere. H. Schaeffer, 709,247, 1/13/31.

Mining tool with hard-metal tip. Gewerkschaft Wallram, Addition 38,958 (1st addition to 696,198 filed 5/28/30), 8/27/30.

Improvements to processes for making nickel carbonyl. The Mond Nickel Co., Ltd., 709,381, 1/15/31.

Improvements to processes and apparatus for the electrolytic production of light metals. Soc. d'Electrochimie, d'Electrométallurgie et des Aciéries d'Ugine, 709,476, 4/18/30.

Method of equalizing the pressure in the grooves in the rolls of pilger mills. Vereinigte Stahlwerke Akt.-Ges., 709,616, 1/19/31.

Pack-annealing furnace with screw conveyor. H. Lindhorst, Addition 38,964 (1st addition to 680,924 filed 8/28/29), 8/29/30.

Improvements in the heat treatment of ferrous metals. A. P. & G. Mahoux, Addition 38,999 (1st addition to 700,049 filed 11/18/29), 2/27/30.

Process and mill for rolling sheet metal. J. R. Spear, *et al.*, 709,326, 11/28/30.

Process and apparatus for cleaning metal objects. W. Frey & Co., 709,338, 12/31/30.

Improvements to arc welding apparatus. J. E. J. Languepin, 709,346, 1/8/31.
Process for making bearings by centrifugal casting. Th. Goldschmidt Akt.-Ges., 709,349, 1/9/31.
Improvements in the manufacture of finished and semi-finished steel objects. Timken Holding & Development Co., 709,359, 1/14/31.
Rolling mill. F. Krupp Grusonwerk Akt.-Ges., 709,382, 1/15/31.
Means for rolling up spools or coils of wire or the like in the drawing of wire and the like. Morgan Construction Co., 709,384, 1/15/31.
Press for drawing hollow objects. F. Krupp Akt.-Ges., 709,359, 1/16/31.
Induction furnace. H. Zepernick, 709,580, 1/17/31.
Method and means for operating several arc furnaces in parallel, using rectifiers and a common transformer. Akt.-Ges. Brown, Boveri & Cie., 709,673, 1/20/31.
Salt bath furnace. Siemens-Schuckertwerke Akt.-Ges., Addition 38,953 (1st addition to 699,179 filed 7/21/30), 8/22/30.
Process for making articles which are to be machined with chip-removing tools. Sachsische Gussstahlwerke Dohlen Akt.-Ges., 709,828, 1/16/31.
Alloys of copper, tin, silver and nickel. R. Ozlberger, 709,850, 1/22/31.
Mechanism for polishing rolls of hot-rolling mills. Continental Can Co., Inc., 710,014, 1/27/31.
Process and apparatus for the direct conversion of molten metals or molten alloys into solid products. H. Harris, 710,099, 1/28/31.
Improvements to foundry molding machines. British Insulated Cables, Ltd., 709,786, 9/24/29.
Tube. Bundy Tubing Co., 709,911, 1/24/31.
Improvements in the heat treatment of metal objects, particularly rails. Bethlehem Steel Co., 709,949, 1/26/31.
Machine for electrically welding wires or an ensemble of wire. Vereinigte Stahlwerke Akt.-Ges., 709,994, 1/27/31.
Process and product for protecting aluminum, magnesium, zinc, and their alloys against corrosion. Soc. Continentale Parker, 710,042, 4/24/30.
Process for pressing rods and wire. Hirsch, Kupfer- und Messingwerke Akt.-Ges., 710,076, 1/28/31.
Pressure tanks for apparatus for cleaning castings with a mixture of sand and water. Badische Maschinenfabrik, 710,082, 1/28/31.
Improvements to processes and machines for arc welding. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 709,795, 12/12/30.
Method of utilizing the heat of melting furnaces. Vereinigte Stahlwerke Akt.-Ges., 709,975, 1/26/31.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for making metal handles covered with a heat resistant composition by compound casting. Aluminium Walzwerke Wutöschingen G. m. b. H., 529,351, 3/2/29.
Roasting furnace for the continuous roasting of sulfide ores. I. G. Farbenindustrie Akt.-Ges., 529,700, 6/23/27.
Process for reducing crude ores containing zinc, lead and similar volatilizable metals. F. L. Duffield, 529,431, 11/15/28; Great Britain 8/4/28.
Process for preventing deep corrosion of base metals. I. G. Farbenindustrie Akt.-Ges., 529,606, 10/11/27.
Process for making pipe coils of any desired section out of metal strip. D. Smith, Ltd., & D. Smith, 529,753, 6/21/29.
Copying device, particularly for torch cutting machines. C. Krebs, 529,677, 1/26/29.
Reversible drive, particularly for reversing rolling mills. J. M. Voith, 529,872, 12/10/29.
Return guide trough for roll trains. Vereinigte Oberschlesische Hüttenwerke Akt.-Ges., 530,040, 5/22/30.
Wire-drawing machine. Vereinigte Deutsche Metallwerke Akt.-Ges., 530,-275, 12/1/27.
Device for loading lead into vertical lead-pipe or cable presses. Hydraulik G. m. b. H., 529,873, 3/7/29.
Process for making finned tubing. M. Schlötter, 529,964, 8/30/29.
Process for making sponge chrome-iron and sponge chromium. H. G. Flodin, 530,030, 3/29/28; Sweden 11/17/27.
Nipple for use in carrying and for screwing together the sections of electrodes for electric furnaces. Siemens-Planiawerke Akt.-Ges. für Kohlefabrikate, 529,837, 12/25/29.
Controllable welding limit device. Siemens-Schuckertwerke Akt.-Ges., 530,061, 5/21/26.
Transformer, particularly for arc welding. Allgemeine Elektricitäts Ges., 530,062, 6/30/29.
Welding compass for welding non-circular objects. Siemens-Schuckertwerke Akt.-Ges., 530,063, 6/5/27.
Channel stone made of separately produced core pipe and sheath. W. Studte, 529,899, 3/8/30.
Process for making compound castings, particularly rolls. Vereinigte Stahlwerke Akt.-Ges., 529,838, 5/14/30.
Removing iron from copper salt solutions containing ferrous salts. I. G Farbenindustrie Akt.-Ges., 529,903, 11/13/29.
Process for forming electrolytic deposits of metals of the platinum group. Baker & Co., Inc., 529,848, 5/16/30; U. S. 7/2/29.
Finder and lifter for articles dropped into electrolytic baths. A. Jensch, 530,017, 11/19/30.
Process for forming metallic deposits. I. G. Farbenindustrie Akt.-Ges., 529,849, 6/28/28.
Process for making metal surfaces particularly those of aluminum and magnesium, resistant to high temperatures. The Expanded Metal Co., Ltd., 530,018, 3/3/27; Great Britain 3/17/26.
Burner for autogenous cutting under water. H. Töpper, 530,465, 7/31/29.
Device for separating or opening thin sheets rolled in packs. J. Doubs, 530,357, 2/28/29.
Tube-rolling mill for making small tubing. Mannesmannröhren-Werke, 530,368 (Addition to 440,654), 8/21/27.
Roll, particularly for the hot-rolling of metals. Siemens-Schuckertwerke Akt.-Ges., 530,484, 7/28/27.
Wire reel. H. Böcher, 530,466, 11/19/29.
Horizontal extrusion press. F. Krupp Grusonwerk Akt.-Ges., 530,467, 3/25/28.
Method of making a welded pipe connection, with welded seam relieved from stress. F. Heck, 530,561 (Addition to 501,377), 6/15/27.
Process for reducing iron ores with gases. I. G. Farbenindustrie Akt.-Ges., 530,568 (Addition to 528,347), 7/2/25.
Process for producing sponge iron from iron ores. F. Krupp Akt.-Ges. Fried. Alfred Hütte, 530,569 (Addition to 529,136), 9/21/29.
Guide elements for foundry molds. E. Borner, 530,510, 9/18/30.
Process for working up sulphidic iron ores containing copper and lead, and optionally zinc and other metals. Verein für chemische u. metallurgische Produktion, 530,516 (Addition to 526,610), 2/6/29.
Process for the electrolytic separation of gold. H. Paweck, *et al.*, 530,525 11/7/29, Austria 7/13/28.
Apparatus for making objects by the electrolytic deposition of metal on a form. G. Rosenqvist, 530,605, 10/25/29.
Process for making draw plates for drawing wires. Electrical Research Products, Inc., 530,778, 4/4/29; U. S. 4/12/28.
Process for making double-walled vessels. Ges. für Linde's Eismaschinen Akt.-Ges., 530,779, 10/9/28.
Head for slot burners for the surface hardening of objects. C. V. Haryes, 530,884, 9/13/30.
Process for extruding long objects, such as pipe or bars. F. Singer, 531,294, 1/13/25; U. S. 10/11/24.
Throat closure. Kölsch-Fölzer-Werke Akt.-Ges., *et al.*, 531,160, 11/19/29.
Hearth furnace burner using gaseous fuels. Witkowitzer Bergbau u. Eisenhütten-Gewerkschaft, *et al.*, 531,206, 12/21/24.
Process for the bright-annealing of iron and steel objects in thin sheet iron covers, and covers for working the process. Siemens-Schuckertwerke Akt.-Ges., 530,865, 4/1/26.
Electric soldering device, in which the element used for soldering is connected to the secondary of a stationary transformer. Elektrische Löt- u. Schweiss G. m. b. H., 531,288, 7/5/29.
Arrangement of the electrodes of electrically heated rotary furnaces. A. Johnson & Co., 531,350, 12/8/29; Sweden 12/10/28.
Interchangeable resistance heating for electric heat treating furnaces with several heating zones. E. F. Russ, 531,351, 11/28/29.
Means for the simultaneous operation of several arc furnaces in one plant Akt.-Ges. Brown, Boveri & Cie., 531,349, 2/5/29.
Induction furnace with laterally situated, completely full channel. H. Zepernick, 531,302, 1/18/30.
Method of cooling the coils of induction furnaces. Société Générale d'Applications Electro-Thermiques, 531,352, 3/28/30; France 3/27/29.
Means for operating furnaces. Allgemeine Elektricitäts Ges., 531,353, 4/18/30; U. S. 4/17/29.
Electric resistance welding machine with controllable welding voltage. F. Hellmuth, 531,354, 5/9/29.
Means for welding base plates to iron ties. Siemens-Schuckertwerke Akt.-Ges., 531,062, 4/14/26.
Furnace installation consisting of a reverberatory furnace and a charging shaft through which the waste gases flow from the former. F. Wüst, 531,064, 8/7/26.
Tilting, gas- or oil-fired hearth melting furnace. W. F. Sklenar, 530,914, 8/14/29; Great Britain 10/22/28.
Melting furnace for cast steel, malleable cast iron, enameling, etc. H. Tholen, 531,065, 9/16/27.
Furnace which tilts about an axis passing near its tap hole. Siemens & Halske Akt.-Ges., 531,146, 1/20/29.
Remelting furnace for scrap linotype metal and other cast metal. Maschinenfabrik Winkler, Fallert & Co., 531,310, 6/28/30.
Drying furnace for foundries. H. Küppers, 530,985, 8/4/27.
Wind regulating device for cupolas. J. E. Fletcher, 530,986, 5/11/30; Great Britain 5/24/29.
Device for protecting the metal issuing from melting pots against oxidation. Felten & Guilleaume Carlswerke Akt.-Ges., 531,022, 5/22/30.
Hand rammer. H. Leis, 530,915, 3/10/29.
Process and device for making sand molds for pipes and similar castings, by compressed-air rammers. K. Pardun, 531,023, 2/15/30.
Jolt molding machine. G. Zimmermann, 531,024, 12/24/29.
Process and molding machine for filling molds and core boxes with molding sand. A. Stahn, 531,025 (Addition to 524,373), 7/30/30.
Gas-absorbing composition for facing molds for making fluid-tight metal castings. F. Grotthaus, 530,916, 3/6/29.
Knock-out device for centrifugally cast pipes. Bayerische Berg-Hütten- u. Salzwerke Akt.-Ges., 530,917, 1/11/30.
Pouring trough for centrifugal molds rotating about a horizontal axis. Buderusche Eisenwerke, 530,918, 9/2/30.
Process for making composite castings. G. Pemetzrieder, 530,919 (Addition to 525,225), 5/9/30.
Process and machine for making centrifugally cast pipes. Ferric Engineering Co., 531,106, 9/25/29.
Process and device for making cylindrical bushings with a hardened inner surface. T. R. Pawlikowski, 531,107, 9/13/29.
Process for making hollow ingots by centrifugal casting. Vereinigte Stahlwerke Akt.-Ges., 531,174, 10/17/29.
Introduction of gases, vapor or liquids into molten baths at high temperature. F. Krupp Akt.-Ges. Fried. Alfred Hütte, 531,315, 6/12/29.
Working up alloy scrap. P. Kemp, 531,066, 5/12/28; Austria 6/23/27.
Process for detinning tin plate scrap or other tin-bearing material. E. Kardos, 531,112, 8/2/29; U. S. 8/30/28.
Process for improving alloys containing copper as the major component, nickel or cobalt or a metal of the platinum group, and silicon. Metallges. Akt.-Ges., 531,304, 4/18/25.
Device for dipping steel and other metal pipes, bars and the like for the purpose of pickling, cleaning, galvanizing, etc. The Perfecta Seamless Steel Tube & Conduit Co. (1923), Ltd., *et al.*, 531,036, 4/17/29; Great Britain 5/10/28.
Device for the continuous spraying of molten substances. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 531,069, 12/30/28.
Electrically heated tunnel furnace with two trains of cars moving in opposite directions. L. Riedhammer, 530,993, 7/21/28.
Molding machine for making all kinds of cores, operated with compressed air. F. Rolff, 531,559 (Addition to 496,383), 12/17/29.
Molding machine, especially for foundries. G. Zimmermann, 531,594, 8/-30/30.
Casting mold made of ceramic material. Deutsche Ton- u. Steinzeug-Werke Akt.-Ges., 531,630, 12/28/26.
Method of heating the sink-heads or risers of ingots and castings. E. Schwarz, 531,412, 5/31/29.
Bimetal obtained by welding a sheathing of copper-zinc alloy to an iron core. Vereinigte Deutsche Metallwerke Akt.-Ges., 530,807, 4/21/27.
Gas cut-off for welding burners. J. B. Barge, 531,512, 5/8/28; France 11/-29/27 & 3/30/28.
Rolling mill for rolling shapes. F. Möller, 531,611 (Addition to 513,122), 1/8/31.
Process for making steel rods. Stahlwerke Westig Akt.-Ges., 531,514, 12/-28/30.
Process for making metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 531,479, 2/13/30.
Process for making molybdenum carbonyl. Same patentee, 531,402, 1/21/30.
Process and means for making steel in the basic converter. P. Ries, *et al.*, 531,627, 1/9/29; Belgium 4/26/28.

Refractory lining for electric induction furnaces. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 531,621, 12/25/27.

Electric bright-annealing furnace. Siemens-Schuckertwerke Akt.-Ges., 531,484, 8/7/26; Austria 6/24/26.

Arrangement for connecting a non-ferrous induction furnace directly to a three-phase supply system. Hirsch, Kupfer u. Messingwerke Akt.-Ges., 531,409, 3/3/28.

Means for connecting carbon electrodes, especially those of electric furnaces. Siemens-Planiawerke Akt.-Ges. für Kohlefabrikate, 531,490 (Addition to 520,394), 12/2/28.

Regulating device for polyphase electric furnaces, having a compensated relay. Siemens-Schuckertwerke Akt.-Ges., 531,491, 4/29/26.

Heat insulation for melting crucibles. E. Brabandt, 531,368, 7/6/30.

Machine for making casting molds. E. O. Beardsley, *et al.*, 531,431, 10/11/29; U. S. 10/19/28.

Molding sand feed device for sand-projecting molding machines. S. Kurze, 531,593, 3/1/29.

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MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

1001 **Large Castings.**—An article entitled "Massive Castings Made with Cores in New Steel Foundry" has been reprinted from Iron Age by the Foundry Equipment Company, Cleveland, Ohio. It is a description of the new plant of the General Steel Castings Corporation in which is installed the world's largest core oven completely designed and built by the Foundry Equipment Company. Interesting illustrations add to the article.

1002 **Gages.**—Circular No. 104 sent out by the Amthor Testing Instrument Co., Inc., 309 Johnson St., Brooklyn, N. Y., describes their mercury column gage for low pressure and vacuum. Several interesting features of this gage are pointed out and prices are given.

1003 **Metal Cleaner.**—The Udylite Process Co., Detroit, Mich., has distributed a folder announcing two metal cleaners prepared by them;—No. 7 for cleaning iron and steel prior to plating and No. 11, a low alkali cleaner for copper, brass and bronze, die cast and aluminum.

1004 **Foundry Equipment.**—Bulletin GEA-1413 of the General Electric Co., Schenectady, N. Y., is a 51-page booklet describing their electric equipment for foundries. This includes a page on lighting for foundries and a page on X-ray equipment for radiographic inspection. The same company has sent out several small leaflets, one devoted to their soldering iron, one to their heating devices and another to their controllers.

1005 **CO_2 Meters.**—A long period of research and development preceded the placing on the market of the L & N CO_2 meters but now the company is able to offer power plant operators a meter which will measure CO_2 to an accuracy within one-half of one per cent, while requiring comparatively little attention on the part of the operator. These meters are described in Bulletin No. 781 of the Leeds & Northrup Co., Philadelphia, Pa.

1006 **Electric Furnaces.**—The Pittsburgh Electric Furnace Corp., Pittsburgh, Pa., has distributed a reprint of "Continuous Melting from Cold Stock of Gray Iron in Electric Furnace" which is a paper presented by N. L. Turner at the 1930 Convention of the American Foundrymen's Association. This is a description of one of the company's furnaces which is in operation at the Beach Foundry, Ltd., and gives complete operating data and costs.

1007 **Cadalyte.**—A number of facts about this process and product for cadmium plating are noted in a leaflet sent out by the Grasselli Chemical Co., 629 Euclid Avenue, Cleveland, Ohio.

1008 **Potentiometers.**—The Leeds and Northrup Type K potentiometer is a thoroughly standardized instrument for measuring electromotive force with high precision and has a diversity of application. It is described and illustrated in Bulletin No. 755 sent out by the company.

1009 **Gear Blanks.**—A single page bulletin describing gear blanks made of arc-welded rolled steel has been sent out by Lukenweld, Inc., Division of Lukens Steel Co., Coatesville, Pa. This short bulletin is preliminary to a more complete engineering bulletin to be published later.

1010 **Udylite.**—Several interesting and unusual uses for this plating are brought out in the July issue of the Udylite News, published by the Udylite Process Co., 3220 Bellevue Ave., Detroit, Mich.

1011 **Metalayer.**—This is a process and apparatus for simultaneously melting, atomizing and spraying on any surface, coatings of any of the commercial metals. An attractive pamphlet illustrating applications of the process for both everyday and special coating work may be procured from the Metals Coating Company of America, 497 N. Third St., Philadelphia, Pa.

1012 **High Pressure Castings.**—An article with this title is a feature of the June issue of Nickel Cast Iron News, published by the International Nickel Company, 67 Wall St., New York, N. Y. This issue also contains number seven of their "Intimate Chats on Metallography," and part II of "Nickel and Nickel-Chromium Cast Iron" by Dr. Merica.

1013 **Precision Borer.**—Catalog No. 534 of the Societe Genevoise d' Instruments de Physique, for whom the R. Y. Ferner Co., Washington, D. C., are the American agents, describes the latest model of their type MP-3C SIP precision borer for the locating, drilling, boring and checking of work-pieces. It shows several new features of these machines added since the first of this type was exhibited at the Power Show last December, which includes drive by motor mounted vertically on the side of the machine, increased height below the cross rail, and a greater range of boring and drilling speeds. This machine has capacity for boring pieces 12" x 18" at one setting.

1014 **Testing Machines.**—Alfred Suter, 200 Fifth Avenue, New York, N. Y., is the American agent for Losenhausenwerk, Düsseldorf, Germany, manufacturers of testing machines of all kinds. A loose-leaf catalog, prepared by the German company, illustrates their different machines, including hardness testers, measuring devices, fatigue testing machines, etc.

1015 **Material Handling.**—An interesting article on this subject is found in the August issue of "Better Methods" published by the Beardsley & Piper Co., 2541 N. Keeler Ave., Chicago, Illinois.

1016 **Nitralloy.**—The Associated Alloy Steel Company of Cleveland has issued several new pamphlets in their Technical Bulletin Series. They are: "The Straight Chromium Stainless Irons and Steels," "Fabrication of Nevastain, Nirosta and KA2," "Resistance of Nevastain, Nirosta, KA2 and KA4 against Chemical Attack" and "The Physical Properties of Nevastain, Nirosta and KA2." These booklets are full of valuable material for those interested in these products.

1017 **Steels in Special Shapes.**—Cold finished steel bars can be drawn into a variety of odd and unique shapes twenty-four of which are illustrated in a book prepared by the Union Drawn Steel Company of Beaver Falls, Pa. These shapes can be produced with an accuracy of plus or minus 0.002" and their use will lower manufacturing costs and add to the quality of the finished product.

1018 **Metal Testing Machinery.**—Catalog 390 of Louis Schopper, sent out by Testing Machines, Inc., 314 Broadway, New York, illustrates measuring appliances for investigating the strength of materials. Machines for carrying out tests respecting tensile properties, compression, bending, etc., Ball hardness testers and pendulum impact testers are described.

1019 **Furnaces.**—The Parker-Kalon Corporation, 200 Varick Street, New York, has prepared a pamphlet describing their pot furnaces for case hardening by cyanide, heat treating, etc. A drawing is included which shows details of construction and operation. The furnace can be used equally well for tempering, annealing, drawing and blueing.

1020 **Cutting Oils.**—The rapidly increasing use of alloy and other special steels places an added burden on machine tool lubrication and so D. A. Stuart & Company, 2727 South Troy Street, Chicago, have developed unique oil products especially designed for present day conditions. A 62-page booklet telling about them is entitled "The Straight Line to Metal Working Efficiency."

1021 **Tungsten Carbide.**—"Firthite" is the name the Firth-Sterling Steel Company, McKeesport, Pa., have given to their cemented tungsten carbide. They have prepared an attractive booklet which lists uses for this product and gives reports of actual performances of Firthite tools. A price sheet for them can also be obtained.

1022 **Die Casting Machine.**—A folder describing their new size automatic die casting machine has been sent out by the Madison-Kipp Corporation, 20 Wauseba Street, Madison, Wis. This machine—size 12 x 16—is larger and more massive, for a larger range of work and increased production in multiple cavity dies. It is also a precision machine for high production of die castings in all standard alloys.

1023 **Rustless Iron.**—The Superior Steel Corporation, Pittsburgh, Pa., make several different brands of rustless iron and have sent out a booklet which gives the physical properties of the various kinds and shows a number of uses of each. The same company produces a new "Superior Metal" which is said to be ideal for a bright rustless surface that always looks new and is resistant to denting, scratching and corrosion. A folder telling about it is also available.

1024 **Carbonal Process for Carburizing Steels.**—This is the title of the new 12-page Bulletin 931 just published by the Hevi-Duty Electric Company of Milwaukee. The bulletin describes the results and advantages of the Carbonal Process of carburizing in the electric vertical carburizing furnace.

1025 **Hydraulic Tables.**—The Baldwin-Southwark Corporation, Philadelphia, is preparing a series of bulletins, No. 25 of which is intended for those engaged in the design or use of hydraulic equipment. An effort has been made to include data on subjects most frequently needed by such men. The data have been collected from many sources and some have never before been published.

1026 **Heat Treating Furnaces.**—A recent leaflet issued by the Surface Combustion Corporation, Toledo, discusses an installation of their furnace in which fifty axles per hour are normalized and hardened. Illustrations and performance data are given.

1027 **Cold Finished Bar**—Joseph T. Ryerson & Sons, Inc., Chicago, have issued a bulletin recently describing the wide variety of shafting, screw stock and open hearth case carburizing steels in use to-day. Each of these is explained in a non-technical manner, telling what each is used for and why it serves certain purposes to the best advantage. This is Bulletin A.

1028 **Fahralloy.**—An interesting leaflet published by the American Manganese Steel Company, Chicago Heights, tells the story of Fahralloy and its many heat and corrosion resistant applications.

1029 **Furnaces.**—The Electric Furnace Company, Salem, Ohio, has issued a folder illustrating and listing several electric and fuel fired furnaces of the various types recently installed in steel plants.

1030 **Plykrome.**—This is the trade name for a stainless composite steel made by the Plykrome Corporation, 225 Broadway, New York, into tanks, tubes, piping, retorts, etc., and for other general anti-corrosive purposes. It is a stainless steel veneer on a backing of inexpensive mild steel and may be fabricated into tanks, tubes, piping, retorts, etc., and used for other general anti-corrosive purposes.

1031 **Melting Machine.**—The "Schwab" continuous melting machine for lead, tin, stereotype metal, aluminum, zinc, etc., has a full automatic temperature control and greatly increased thermal efficiency. A folder describing it may be procured from Industrial Welded Alloys, Inc., Newark, N. J.

1032 **Castings.**—For unusually hard service the Chicago Steel Foundry Co., uses Evansteel in castings, for high temperature, Pyrasteel. They have sent out a small leaflet giving the physical properties of these alloys. The company's address is Kedzie Ave. at 37th St., Chicago.

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METALLURGICAL ABSTRACTS

A digest of the important metallurgical developments of the world

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METALLURGICAL ABSTRACTS, incorporated in METALS & ALLOYS, is the most complete review of metallurgical literature (periodicals, books, etc.) available. Sixty section editors and abstractors cover over 400 domestic and foreign publications and abstract the articles on metallurgical engineering as well as allied subjects.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform with our style they are classified. The section editors edit the abstracts appearing in the section in which their major interest lies.

There are usually at least two places where an abstract might fit, sometimes even more, and so we decide who will be most interested in the article. We want the abstracts to be so arranged that if a heat treater reads only Section 10 he will keep in touch with all the important articles in his field and if a foundryman will read Section 22 each month he will not miss anything important. An improvement we hope to make in the METALLURGICAL ABSTRACTS in the near future is the cross-indexing of articles, which belong under several sections. Some of the sections are descriptive and some are self-explanatory and we have so labeled them.

CLASSIFICATIONS

0 (General). Under this heading we classify all abstracts which are of interest to the metallurgical industry in general. Compare this with Section 20—miscellaneous.

1, 2, 3 (Properties of Metals, Non-Ferrous and Ferrous Alloys). An article goes under one of these heads when the properties are emphasized and not the method of determining them.

4 (Corrosion, Erosion, Oxidation, Passivity & Protection of Metals & Alloys). This takes articles on weather resistance, resistance to acids, etc., and protection against them.

5a (Structure of Metals & Alloys—Metallography & Macrography). An article would go in this group if it discussed the microscopic or macroscopic study of metals and alloys, or the determination of constitutional diagrams, critical points, etc.

5b (Structure of Metals & Alloys—Structure and X-Ray Analysis). This group includes articles dealing with the structure of metals and alloys as determined by X-ray analysis and X-ray examination.

6 (Physical, Mechanical & Magnetic Testing). If an article emphasizes the method of determining the properties of metals rather than the properties them-

selves it belongs in this section. The abstracts on fatigue appearing under this section are prepared with the coöperation of the Fatigue Research Committee of the American Society for Testing Materials.

7a (Electro-Chemistry—Electroplating). This will include articles on the electrolytic plating of metals.

7b (Electro-Chemistry—Electrometallurgy). This relates to the electrolytic recovery and refining of metals.

8 (Metallic Coatings Other than Electroplating). Articles on galvanizing, metal spraying or dip coating would come in this group.

9 (Industrial Uses and Applications). If the application of the metal is stressed rather than the properties the article belongs in this section.

10 (Heat Treatment). If heat treatment in general is discussed the article would be classed under section 10; if, however, any distinct operation is stressed it would go under the corresponding subhead.

11 (Joining of Metals and Alloys). The explanation for this group is similar to that for section 10.

12 (Working of Metals & Alloys). We feel that the divisions in this group are self-explanatory to men in the metals industries. We might say, though, that an article is classified under 12j (Cold Working) only when it will not fit under one of the other heads—for instance, an article on cold rolling would be put under 12c, rolling.

13 (Defects). This section includes articles dealing with inclusions, segregations, cracks, pinholes, blowholes and failures.

14 (Chemical Analysis). If the method of analysis is emphasized the article goes here.

15 (Historical & Biographical). Self-explanatory.

16 (Economic). Articles in this group are devoted to economic trends, savings, cost estimates, etc.

17 (Plants & Laboratories) This section includes descriptive articles.

18 (Machinery & Supplies). This includes descriptive articles.

19 (Bibliographies). Self-explanatory.

20 (Miscellaneous). This takes in all scattered articles which do not belong anywhere else.

21 (Laboratory Apparatus). Purely descriptive articles belong here. If results or processes are given they would go under 6 or 14.

22 (Foundry Practice & Appliances). This is self-explanatory.

23 (Furnaces & Fuels). This takes in descriptive articles. Otherwise they go under 10, heat treating, 10b, annealing, etc.

24 (Refractories & Furnace Materials). This section is hand-in-hand with 23. Furnace men should read both of them.

25 (Gases in Metals). This is self-explanatory.

26 (Inspection). This includes articles dealing with inspection, pure and simple—not X-ray or microscopic analysis.

27 (Effects of Elements on Metals and Alloys). Articles dealing with the effect of the addition of different chemical elements to metals and alloys are included in this group.

28 (Instruments & Controllers). Descriptive.

29 (Effect of Temperature on Metals and Alloys). This section is prepared in conjunction with the Joint High Temperature Committee of the A. S. T. M. and the A. S. M. E.

30 (Leaching). Self-explanatory.

31 (Reduction Metallurgy). This would include articles on blast furnace practice.

32 (Non-metallic Coatings for Metals and Alloys). Articles discussing painting, enameling, lacquering, etc., belong here.

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It has been our purpose in this outline to make our scheme of classification apparent to our readers and so, perhaps, make the abstract section more useful. If you have any questions pertaining in any way to the abstracts, write to us. We shall be glad to answer them in detail.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

GENERAL (0)

Recent Investigations on Metals. (Nouvelles Recherches sur les Métaux.) EDMOND MARCOTTE. *Arts & Metiers*, Vol. 83, May 1930, pages 210–215.

A brief review of recent investigations carried out in France on protective coatings for metals, detection of internal stresses, annealing of steels in vacuum and tensile tests of nickel and nickel-chromium steels at 450° C. WHB(0)

Manganese Steel and Its Developments. R. HADFIELD. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 261–272.

Brief and very general résumé. HWG(0)

Applications to Iron & Steel Production—Annual Report of the Committee on Applications to Iron & Steel Production. A. C. CUMMINGS, *et al.* *Electrical Engineering*, Vol. 50, July 1931, pages 590–593.

Electric developments in the iron and steel industry during 1930 are traced, particularly in d.c. motors, synchronous motors and auxiliaries. WHB(0)

On Damascene Steel "Taban" and "Khorassan." N. T. BELAIEW. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 111–114.

General discussion with photographs of the two types of blades referred to. HWG(0)

Materials and Structures. By E. H. SALMON. Longmans, Green & Co., New York, 1931. Cloth, $5^3/_4 \times 8^1/_2$ inches, 638 pages. Price $6.00.

The first 391 pages deal with the mathematical calculation of stresses. The next 200 pages discuss the strength of metallic materials. A large number of references to the literature are given so that the student is not led to believe that all the important information is given in the book. In general, this section is moderately well up to date. There are some slips, as it is stated that the steel charge in the ordinary electric steel furnace is heated by the resistance of the charge, and that steel of 0.05–0.25% C cannot be hardened by heat-treatment.

The 18–8 type of steel is dismissed with 3 lines and Mo is not included among alloying elements for steel. On the other hand, the CuCr type of structural steel, the Meyer hardness index and Moser's work on impact specimens of varying widths are mentioned.

A chapter is devoted to endurance testing, in which the main points are dealt with and the effect of keyways, etc., mentioned. "Accelerated" test methods are only mildly condemned. Another chapter relates to high temperature properties, but a curve of creep data from tests lasting only 32 hrs. is shown without comment. The reader is not likely to grasp, from the discussion given, the essentials of creep testing that are necessary for precision. The impression one gets from this part of the book is that the author has read quite widely in the literature of physical testing of metals, but has not had much personal experience with a good many of the tests mentioned.

The last 30 pages are an "Introduction to the Study of Metallography." This is rather sketchy and while it serves to give the budding engineer some idea of the subject and its relation to the engineering properties of metals, it seems doubtful that he will be able to grasp very much of it.

The book gets weaker as one nears the back. The materials testing and metallographic sections seem to be put in because the author feels that they should be included in a course in theory of structures, rather than because he has much personal interest in them. Nevertheless the book is better balanced than if those sections had been omitted, even if they are less authoritatively dealt with than the mathematical section.

The selected bibliographies are rather well chosen and the reader can follow up, from the works of good authorities, the subjects that are none too authoritatively dealt with in this work. On the whole, it should be a rather good engineering text book, but as a reference book for metallurgists it is somewhat elementary and its mediocrity is only relieved by the fact that it is fairly well up to date.—H. W. Gillett (0)-B-

Modern Developments in Alloy Steels. (Neuzeitliche Entwicklung des Edelstahls.) P. GOERENS. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 285–324.

Includes Discussion. Furnace practice is first briefly discussed. The idea of vacuum melting for quality steel is mentioned approvingly. Aging-brittleness and temper-brittleness are mentioned. Structural steels are tabulated as follows:

Kind	Composition % C	Mn	Si	Cu	Cr	Y.P. lbs./in.²	T.S. lbs./in.²	Elongation %
No. 27	0.12	0.40–0.45	0.02–0.05			31,000	52,500	22
No. 48	0.30	0.55	0.12			41,000	68,000	18
Si	0.15	0.80	0.80			51,000	68,000	20
Cu-Cr	0.20	0.80	0.25	0.65	0.50	51,000	68,000	20
Cu-Mn	0.20	1.30	0.40	0.50		51,000	68,000	20

The properties of various heat-treated C, Ni-Cr, Ni-Cr-Mo or W and Cr-Mo-V steels are given. High temperature creep testing and wear testing are very briefly mentioned, as are magnetic properties. High speed steels are mentioned and the statement made that W can be substituted wholly or partly by Mo. Tungsten carbide tools, corrosion resistant steels, heat resisting alloys and nitriding steels are all briefly dealt with. In discussion Kjerrman pointed out the importance of "body" in steel. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 687. HWG(0)

The Engineers Vest Pocket Book. W. A. THOMAS. W. A. Thomas Company, Chicago. $3 \times 5^1/_2$ inches. Price $3.00.

Contains tables and information on mathematics, statics, dynamics, strength of materials, building construction, mechanical design, heat, hydraulics, chemistry, physics, electricity, transportation, surveying and costs.—W. A. Tucker (0)-B-

Iron and Steel (Eisen und Stahl) 97 photographs by Albert Renger-Patzsch with an introduction by Dr. Albert Vögler. Published by Hermann Reckendorf, Berlin, 1931. Bound, $8^1/_2 \times 12$ inches, 84 pages. Price 7.50 R.M.

Albert Renger-Patzsch is at present considered the best industrial photographer in Germany. The subject of iron and steel is divided into several groups of subjects. I. The production of iron and steel shows views in the blast furnace and Bessemer plants; II. In the rolling mill; III. In the foundry and forge shop; IV. In machine construction; V. In marine construction; VI. In bridges; VII. In steel structures; VIII. In cranes; IX. The working of iron and steel.

The photography is unquestionably the work of an artist and the publisher has assisted by executing a printing masterpiece.—Richard Rimbach (0)-B-

Coöperative Technical Research in the Steel Industry. F. N. SPELLER. *Iron Age*, Vol. 127, June 18, 1931, pages 1967–1971.

Includes discussion. Abstracts of a paper read before the American Iron & Steel Institute, May 1931. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 159. VSP(0)

Properties of Metals (1)

Thallium. ALICE V. PETAR. *Information Circular* 6453, *U. S. Bureau of Mines*, June 1931, 6 pages.

The properties, occurrence, uses, production and markets of thallium are discussed. 26 footnote and bibliographic references. AHE(1)

New Data Relative to the Independence of the Hardness and the Hydrogen Content of Electrolytic Metals. (Nouvelles données relatives á l'indépendance de la dureté et de la teneur en hydrogéne des métaux électrolytiques.) GUICHARD, CLAUSSMAN, BILLON & LANTHONY. *Comptes Rendus*, Vol. 192, May 4, 1931, pages 1096–1098.

The authors continue the discussion of the relationship between the hydrogen content of electrolytic metal and its hardness, which has been the subject of controversy between them and Guillet and Cournot. They bring forward evidence to prove that no such relationship exists, quoting the results of experiments on 5 different samples of electrolytic iron and also on other larger amounts of the same material. OWE(1)

The Geo-Chemistry of Rhenium. (Die Geochemie des Rheniums.) I. & W. NODDACK. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 154, Apr. 1931, pages 207–244. 15 references.

The authors consider at length the physical and chemical properties of rhenium and draw conclusions in regard to the geo-chemical behavior of this "rare element." The distribution of rhenium in the earth crust as well as in the cosmos is established by chemical analyses of a great variety of minerals (about 1600) and of some 60 meteorites, respectively. Furthermore, 1200 X-ray spectrograms were taken. The most important results of the exhaustive research are tabulated. Stress is laid on the occurrence of rhenium in sulphuric minerals. EF(1)

The Electrical Resistivity of Silicon. (Sur la résistivité électrique du silicum.) CU. BENDEL. *Comptes Rendus*, Vol. 192, Mar. 30, 1931, pages 802–804.

The author describes the results of experiments on the electrical resistivity of silicon, in which he used silicon containing about 0.1% of iron, a commercial product containing 1.4% of iron and a ferro-silicon of which the iron content was as much as 8.5%. The effect of iron upon the electrical resistivity of pure silicon was shown to be quite considerable, the mean value for the electrical resistivity of the sample containing 0.1% iron being 0.267 ohms-cm. For the other samples the following values were obtained: 0.069 for the 1.4% iron alloy, and 0.035 for the 8.5% iron alloy. OWE(1)

The Influence of Purity on the Variations of the Mechanical Properties Produced by Rolling and Annealing of Aluminum. (Influence de la purete de l'aluminium sur la variation de ses proprietes mechaniques par lamination et par recuit.) JEAN CALVET. *Revue de Métallurgie*, Vol. 28, Mar. 1931, pages 162–164.

Physical properties of very pure (Hoope's)aluminum and commercial aluminum were compared in cast and severely rolled state before and after several heat treatments. For cast metals the best annealing temperature is 400° C. for purer metals and 350° for commercial grades. The full influence of annealing is developed in very pure aluminum at a lower temperature (200–250°) than in commercial alloys. JDG(1)

Magnesium. Industry's Lightest Structural Metal. JOHN A. GANN. *S. A. E. Journal*, Vol. 28, June 1931, pages 653–668.

After reviewing briefly the history of the aluminum and magnesium industries, the author describes foundry practice in the production of magnesium and magnesium-alloy castings, their heat-treatment and the effect of various fabrication processes on the microstructure and physical properties. The general classes of commercial magnesium-base alloys now in use in this country are discussed at some length with particular reference to the combination of extreme lightness with good physical and mechanical properties that is obtained. Applications of magnesium alloys in the aircraft and automobile industries are outlined in a section of the paper. Many of these are illustrated. In conclusion the author states that the importance of magnesium as a structural metal is now being recognized, especially as the factors that have retarded its development and restricted its use are overcome. (1)

Status of the Knowledge of Super-conductivity. (Der Stand der Forschung über die Supraleitfähigkeit.) W. MEISSNER. *Metallwirtschaft*, Vol. 10, Apr. 10, 1931, pages 289–295; Apr. 17, 1931, pages 310–313; *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, page 311.

A lecture before the German Society of Technical Physics and the Berlin Physical Society. Contains a bibliography of 75 references. A review of recent investigations. EF+CEM(1)

Some Experiments on the Strain-Hardening Induced in Iron and Stee by Certain Types of Mechanical Deformation—with Special Reference to D-Links for Colliery Tram Shackles. W. R. D. JONES. *Proceedings, South Wales Institute of Engineers*, Vol. 47, Feb. 26, 1931, pages 23–71.

Drilling does not introduce any irregularities in hardness in the vicinity of holes. Drifting and punching bring about hardened areas on the surface near the holes. Stressing of D-links has shown that drop forged links have considerably better properties than hand-forged and that mild steel is superior to wrought Fe. Mild steel showed greater shock resistance than wrought Fe by the Charpy impact test. There is a critical amount of work-hardening for each material as regards the best impact values. Annealing at 900° C. reduced the shock resistance. Includes 29 references. AHE(1)

The Freezing Point of Platinum. W. F. ROESER, F. R. CALDWELL & H. T. WENSEL. *Bureau of Standards Journal of Research*, Vol. 6, June 1931, pages 1119–1120.

In determining the freezing point of platinum on the International Temperature Scale, measurements were made of the ratio of brightness of black bodies maintained at the freezing points of gold and platinum. The black bodies used were hollow inclosures of fused thorium oxide immersed in the molten metals. Observations were made during the freezing of the metals. Two optical pyrometers were used and observations were obtained on two separate lots of pure platinum by three observers. The metals were heated in air using a high frequency induction furnace to secure automatic stirring of the freezing metals and to avoid contamination from furnace windings. The freezing point was found to be 1773.5° C. WAT(1)

Investigations of the Influence of Different Intermediary Annealing Temperatures on the Technological and Chemical Properties of Aluminum Sheet. (Untersuchungen über den Einfluss verschiedener Zwischenglühtemperaturen auf die technologischen und chemischen Eigenschaften von Aluminiumblech.) H. RÖHRIG. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 237–238.

The chemical resistivity of hard aluminum sheet can be made equal to that of properly soft annealed sheet by an intermediary annealing at 600° C. without impairing the technological properties. The final annealing temperature of 450° C. equalizes the various effects of the intermediary annealing. The sheet annealed at this temperature attains the best chemical resistivity and technological properties. The tests are given in detail. Ha(1)

The Temperature Dependence of Crystal Elasticity. II. (Ueber die Temperaturabhängigkeit der Kristallplastizität. II.) W. FAHRENHORST & E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVIII, 1931, pages 26–30.

See *Metals & Alloys*, Vol. 2, Mar. 1931, page 62. (1)

The Preparation and Properties of Chemically Pure Metals. (Ueber die Herstellung und Eigenschaften chemisch reiner Metalle.) M. L. V. GAYLOR. *Metallwirtschaft*, Vol. 9, Aug. 15, 1930, pages 677–679.

Contains 7 references. In the preparation of pure metals very pure materials must be used, especially crucibles. SiO_2 crucibles are suitable for preparing Si, and Al_2O_3 crucibles for Fe, Mn and Cr. *Iron.* Electrolytic Fe made with very pure anodes from $FeCl_2$ solution can be obtained containing only traces of P. It oxidizes when exposed to air. Most of the oxide can be removed by heating for several hours at 900–1000° C. in a stream of dry hydrogen. It can be rolled into thin sheets. The last traces of O can be removed by treating the liquid metal with H at reduced pressure. The magnetic properties of electrolytic iron are better than commercial silicon steel but those of the iron treated in the liquid state are not as good. *Chromium.* Cr is prepared by electrolysis of 30% H_2CrO_4 and 1% H_2SO_4 solution in a water cooled lead tank, the tank forming the anode. The cathode is vertical tube, 3" dia., closed at the bottom, and rotated by a motor. In 10 g. of Cr prepared in this way no S, Pb, Al or Fe were found by analysis. H is removed by heating to 600° C. The O which it contains is not removed by melting in vacuum. The microscope shows that Cr_2O_3 is formed. This can be reduced by melting in a high frequency induction furnace at 1500–1600° C. in a rapidly circulating stream of H. The spectroscope shows no metallic impurities in the resulting metal. Electrolytic Cr is very hard and brittle, but after H is removed it becomes softer. *Manganese.* Mn prepared by the Thermit process, containing 3–4% impurities, is distilled in a vertical quartz tube in a high frequency induction furnace at 1–2 mm. pressure at a temperature just above the melting point. The distilled metal analyzes S nil, Si 0.002, Fe and Al trace, P 0.003, N <0.002. It is silver gray and very hard and brittle. When cooling below 800° C. it cracks. During cooling allotropic changes take place at 1191°, 1024°, 742° and 682° C. At one of the lower 2 points a volume change takes place which is the cause of the cracking. X-ray study shows a cubic crystal structure. The edge of one cube is 8.894 ± 0.002 A. U., density 7.44 g./cc. The elemental cube contains 58 atoms beta Mn, between 742° and 1024° also has a cubic lattice, 6.29 A. U. long, 20 atoms per cube. *Silicon.* The impurities in Si consist of silicates of Fe and Al and silicides of Fe, Ca and Mg at the grain boundaries. The Si is finely powdered in a mortar and treated with acid in a large beaker to dissolve the impurities. The residue is filtered, washed with water, treated with conc. HCl, diluted, filtered, washed and dried. Analysis: Insoluble 0.006, Fe 0.02, Al 0.02, Ca 0.009. Under the microscope the Si appears very pure, with twinned crystals. It is blue green, very hard and brittle. *Beryllium.* Be is prepared by electrolysis in a special apparatus from fused $BeF_2.NaF$ to which BaF_2 is added to bring the Ba up to 10–15%. A Cr Ni container and graphite anodes impregnated with pure NaCl are used. Be is hard, steel gray, has a high luster and is not attacked by the atmosphere. It is not ductile and is difficult to work. It is attacked by dilute acids and alkalies, but not by conc. HCl and H_2SO_4. Melting point about 1280° C. CEM(1)

Bismuth. PAUL M. TYLER. *United States Bureau of Mines Information Circular* 6466, July 1931, 19 pages.

Bismuth is discussed under the following headings: properties, uses, occurrence, extraction, production, imports, exports, foreign industry and lists of producers and consumers. 13 footnote references are given. AHE(1)

Progress in Production and Use of Tantalum. GEORGE W. SEARS. *Transactions American Institute Mining & Metallurgical Engineers*, 1930, pages 317–321.

Includes discussion. See *Metals & Alloys*, Vol. 1, Apr. 1931, page 471. (1)

Rhenium (and Masurium). PAUL M. TYLER. *United States Bureau of Mines Information Circular* No. 6475, July 1931, 17 pages.

Tyler discusses the properties, identification, occurrence, extraction and preparation, production and use of rhenium. Over 50 footnote and bibliographic references (with abstracts) are given. AHE(1)

I. The Specific Heats of Thallium, Calcium and Magnesium Measured to 10° Absolute. II. The Entropy and Chemical Constants of Magnesium from Spectroscopic Data. K. CLUSIUS & J. V. VAUGHEN. *Journal American Chemical Society*, Vol. 52, Dec. 1930, pages 4686–4699.

The specific heats of thallium, calcium and magnesium have been measured from 10° to 200° A. The vapor pressure constant of magnesium has been determined as 0.443 ± 0.1 and is found to agree very well with the statistically calculated value 0.493. The entropy of monatomic magnesium vapor at atmospheric pressure and 25° has been determined empirically at 35.29 units, while the theoretical value is 35.51. MEH(1)

Has Aluminum An Inversion Point? (Hat das Aluminium einen Umwandlungspunkt?) A. SCHULZE. *Elektrotechnische Zeitschrift*, Vol. 52, Mar. 12, 1931, page 358; *Zeitschrift für Physik*, Vol. 49, July 1928, page 146.

Experiments made with Al of 99.94% purity to higher than 600° C. shows conclusively that with increasing purity all discontinuities disappear, so that up to 600° C. aluminum does not possess an inversion point. Ha(1)

Tantalum. H. M. BASSETT. *Foundry Trade Journal*, Vol. 44, May 28, 1931, pages 366, 368.

A brief note on the reduction of tantalum and its uses. OWE(1)

The Dependence of the Alternating Current Resistance of Iron Wires upon Mechanical Tension. (Die Abhängigkeit des Wechselstromwiderstandes eiserner Drähte von mechanischer Spannung.) B. SAADIKOV. *Archiv für Elektrotechnik*, Vol. 25, June 19, 1931, pages 431–435.

A number of curves show the change of resistance of an extended iron wire at different tensions when an alternating current flows through the wire. For wires from 1 to 6 mm. diameter, a continued decrease was observed from 0 to 140 kg. tension, for ohmic as well as for the reactive resistance and, therefore, for the impedance. The reason given for this phenomenon is that a mechanical tension exerts an influence on the circular magnetic permeability of the Fe on which the alternating current resistance depends. Ha(1)

The Atomic Weight of Uraninite Lead from Wilberforce, Ontario, Canada. GREGORY PAUL BAXTER & ALLEN DOUGLASS BLISS. *Journal American Chemical Society*, Vol. 52, Dec. 1930, pages 4851–4853.

Value found for lead from uraninite is 206.195, the average of two determinations. MEH(1)

The Manufacture of Chemical Sheet Lead. R. S. RUSSELL. *Chemical Engineering & Mining Review*, Vol. 23, July 6, 1931, pages 389–391.

The British and the American standard specifications for "chemical lead" are regarded as not quite corr ct. Maximum limits for any one impurity are: Ag 0.002%, Bi 0.005%, Fe 0.003%, Sb 0.004%, Zn 0.002%, Cu 0.001%, Ni and Co together 0.001% Sn, Cd and As traces, and the Pb content obtained by difference must be no more than 99.99%. The rolling process is outlined. The fatigue limit of Pb determined on the Haigh machine is ±0.2 tons/in.², that is, 10,000,000 reversals of a stress of 0.2 tons/in.² will cause failure at ordinary temperature. At 100° C. the fatigue limit is about 4/5 that at ordinary temperature, and at 150° it is reduced to less than half. The remedy for fatigue failure lies in (1) elimination of vibration, (2) working at as low a temperature as possible, (3) preventing changes of temperature, and (4) supporting the Pb as completely as possible. WHB(1)

The Atomic Weight of Uranium Lead from Swedish Kolm. GREGORY PAUL BAXTER & ALLEN DOUGLASS BLISS. *Journal American Chemical Society*, Vol. 52, Dec. 1930, pages 4848–4851.

An average atomic weight is given as 206.013 for uranium lead. MEH(1)

Tungsten. WILLIAM CRAWFORD HIRSCH. *Electrical Manufacturing*, Vol. 7, June 1931, pages 43–45.

The uses and properties of tungsten are presented. WAT(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Light Metals & Alloys, Cast and Wrought. Report of A. S. T. M. Committee B-7. J. B. JOHNSON, Chairman. *Preprint* No. 23, for June 1931 meeting, *American Society for Testing Materials*, 10 pages.

Tentative specifications for sand cast Mg-base alloys are proposed covering the following:

% Mg	% Al	% Mn min.	% Cu	% Cd	% Impurities	Tensile lbs./in.²	Elong. 2" in 2 in.	
Bal.	5.5–7.0	0.2	0.1 max.	.....	0.3 max.	24,000	4	
Bal.	6.5–8.5	0.2	0.1 max.	.....	0.3 max.	24,000	4	as cast
						29,000	6	heat treated
Bal.	1.7–2.3	0.2	3.5–4.5	1.6–2.4	0.3 max.	21,000	2	

From the former tentative specifications for Al-base sand cast alloys, the one of 8% Si, 3½% Cu is now omitted, and other minor changes made. Analytical methods for Mg alloys are to be drawn up in the form of a tentative standard. Tentative specifications for Al-alloy wire, rods and bars, Mg-base alloy sheet and wrought shapes have been recommended to the society, but have not yet been published. HWG(2)

Photo-Electric Effect of Aluminum and Aluminum Amalgams. (Der lichtelektrische Effekt des Aluminiums und der Aluminiumamalgame.) H. GERDING (University of Amsterdam). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. XI, Dec. 1930, pages 1–37.

Deals with the phenomenon of passification as met on surfaces of Al, Cr, Fe, etc. The photo-electric sensitivity of Al and its amalgams during scratching in vacuo is studied and the photo-electric fatigue by oxygen absorption interpreted. 70 references. EF(2)

Slowly Age-Hardening Silver Alloys. (Ueber vergütbare, schwer anlaufende Silberlegierungen.) J. A. A. LEROUX & E. RAUB. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 58–63.

The preparation and properties of silver-copper alloys for silverware modified by added metals (chiefly Zn, Cd and Ni) to diminish tarnishing were studied (cf. Jordan, *Technical Paper Bureau of Standards*, Vol. 21, 1927, page 459). An alloy with 83.5% Ag, 12.32% Zn, 4.18% Cu proved difficult to homogenize by annealing, very persistent coring obtaining. After hammering "in three directions," annealing at 520° C. for 2 hours produced a homogenized structure. The solubility of Cu in the Ag-Zn solid solution was determined. It was found that the diffusion of Cu in the Ag-Zn solid solution was much more rapid than in pure Ag. It was found that Cu dissolves to an extent of 7% in the Ag-Zn solid solution at 700° but not over 1% at 280°. These solubility determinations apply as well to an alloy with 92.5% Ag as to one with 83.5% Ag. These values approximate those for Cu in pure Ag, and in this sense Zn seems simply to replace an equivalent amount of Ag. This diminishing solubility with temperature suggested a capacity for age-hardening which was confirmed by hardness and tensile strength measurements on an alloy (82.5% Ag, 12.32% Zn, 4.18% Cu) given a typical age-hardening heat-treatment. Curves are given showing the increase in hardness (from 50 to 80 Brinell hardness), decrease in elongation (60 to 30%) and increase in tensile strength (by approx. 6000 lbs./in.²) on alloys quenched from various temperatures and aged at 280°. The considerable scattering in values was attributed to the tendency of the growth of abnormally large grains. An attempt was made to decrease this tendency by adding other metals. Ni was found to be very effective. Photomicrographs are given showing the effect of Ni additions up to 1.5% upon the grain size. Age-hardening determinations were made upon the Ni modified alloy and the data are given in curves. Ni improves the mechanical and age-hardening properties of this alloy. It is shown that the addition of Ni makes diffusion slower and the aging process more sluggish. Comparative aging experiments were run on pure Ag-Cu alloys with 83.5% Ag which showed the aging characteristics to be quantitatively similar to those of the Ag-Zn-Cu-Ni alloy. The diffusion of Cu in Ag is rapid only above 600°. Alloys of Ag-Cd-Cu were also studied. Large amounts of Cd and small amounts of Cu produce a sluggishly aging alloy whereas smaller amounts of Cd and larger amounts of Cu produce a rapidly aging alloy. Ni accelerates aging in these alloys, but these alloys age more sluggishly than Ag-Zn-Cu-Ni alloys. A table of data is given showing the changes in mechanical properties of all these alloys upon aging. EF+RFM(2)

Copper and Copper Alloys, Cast and Wrought. Report of A. S. T. M. Committee B-5. C. H. MATHEWSON, Chairman. *Preprint* No. 21 for June 1931 meeting, *American Society for Testing Materials*. 8 pages.

Changes in the specifications for sheet high brass, to be discussed at the next committee meeting, have been proposed, namely, recognition of 2 grades, use of tensile test for determination of rolled temper, of grain size for annealed, explanation of Rockwell figures on all tempers, and recognition of 5 annealed tempers. A tentative specification for copper water tube is proposed, by which dimensions and bend test are set for standard (for plumbing) and extra heavy (for underground) service. Hydrostatic test to 6000 lbs./in.² is required. Phosphorus-deoxidized copper is called for. The composition is to be 99.9 Cu, minimum; 0.1 P, maximum.

Properties	Soft Annealed	Light Annealed	Hard Drawn
Tensile, lbs./in.²	30,000	32,000	42,000
Elong. in 4 in., %	25	25	....
Grain size, mm.	0.025 to 0.065	Under 0.035	....

HWG(2)

Investigation of the Thermal Expansion of Light Aluminum Alloys. (Untersuchung der Wärmeausdehnung von Aluminium-Leichtlegierungen.) H. SIEGLERSCHMIDT. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 26–30.

The mean thermal expansion between 50° and 520° is given for pure Al annealed, commercial Al annealed, and Al-Cu alloy with 5% Cu in both the annealed and age-hardened state, Lautal in both the annealed and age-hardened state, and Duralumin in both the annealed and age-hardened state. The variations in the expansion curves are correlated with the known internal changes, with special emphasis upon the effect of time of heating and cooling. RFM+EF(2)

Meeting Japanese Iron and Steel Institute. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 19, June 1931, page 89.

Papers read are mentioned and one on a new light alloy of density 2.7 and 27,600 lbs./in.² tensile strength is briefly abstracted. WLC(2)

Metals Used in Building the Airship Do-X. Correspondence from E. W. EHN, Cannstatt, Germany. *Metal Progress*, Vol. 19, Apr. 1931, pages 93–94.

Notes on aluminum alloys. WLC(2)

The Palladium and Rhodium Alloys of Platinum. E. R. THEWS. *Metal Industry*, London, Vol. 38, May 8, 1931, pages 473–474.

Some of the chemical and physical properties and commercial uses of palladium and rhodium alloys of platinum are given. PRK(2)

Aluminum, Magnesium, Beryllium and their Principal Alloys. (Alluminio, Magnesio, Berillio e lore leghe principali.) A. W. BONARETTI. *Metalli Leggeri*, Vol. 1, Jan.-Feb. 1931, pages 74–80; Mar. 1931, pages 133–140; Apr. 1931, pages 191–198 (to be continued).

Serial publication of a "technical guide" to the preparation, technology and applications of light metals and alloys. HWG(2)

White Metals, Brasses and Bronzes. Part 8. E. PERRY. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, pages 512–513.

Fusible alloys used for boiler-plugs, sprinkler valves, etc., are made of metals with low melting point. These alloys are formulated to secure definite melting points for specific purposes. Gives tables giving melting points of various combinations. VSP(2)

Light Alloys. Z. JEFFRIES. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*. Part 4, pages 157–170.

Brief survey of properties of Al and Mg alloys. See *Metals & Alloys*, Vol. 1, Dec. 1929, pages 267–271. HWG(2)

Tempering, Aging and Annealing. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 20, Aug. 1931, pages 86–88.

The writer traces the history and hardness theories developed in connection with light alloys. WLC(2)

Aluminum Brasses. (Les Laitons a l'Aluminium.) L. GUILLET. *Revue Aluminium*, Vol. 6, Mar.–Apr. 1930, pages 1069–1072.

Aluminum added to brass goes into solution in the constituents of the primary alloy. It is known that the addition of a third element to a copper zinc alloy gives a structure which is different from that of the primary alloy, although the phases found are always present in ordinary brasses. Experiments have shown that 1% of aluminum has the same effect as 6% zinc. In connection with this the author shows a method of calculating the quantity of an element to be added in order to give definite amounts of α and β-phases. The special brass has mechanical properties similar to those of ordinary brass having the percentage of copper to give them the microstructure of the special brass. The addition of aluminum gives a structure resembling a brass of lower copper content and increases the tensile strength, elastic limit and hardness while decreasing the elongation and reduction in area. In an aluminum brass of the same structure as the binary brass there is an increase in elastic limit and corrosion resistance. The tensile strength and elastic limit of brasses of the same microstructure are higher the greater the percentage of aluminum. Only brasses containing less than 60% copper can be hot rolled; the addition of only 0.8% aluminum to a 65% copper brass enables it to be hot rolled. (2)

Die Cast Metals & Alloys. Report of A. S. T. M. Committee B-6. H. A. ANDERSON (Chairman). *Preprint* No. 22 for June 1931 meeting, *American Society for Testing Materials*. 13 pages.

Contains report of activities of the committee. Proposed tentative specifications for 7 Al-base alloy die castings are as follows:

No.	Cu	Si	Ni	Fe(max.)	Ten. Str. lbs./in.²	Elong. % in 2″	Charpy ft.-lbs.	Rockwell E.
1	..	5	..	2	29,000	3½	4½	60
2	..	12	..	2	33,000	1½	2	80
3	2	3	..	2½	30,000	3½	5	60
4	4	5	..	2¼	32,000	2	2½	75
5	1½	1	2¼	2½	29,000	4	4½	55
6	4	1¾	4	2½	31,000	1½	2	75
7	8	1½	..	2½	....	..	..	..

Nos. 1 and 2 may contain up to 0.6% Cu, Nos. 1–4 and 7, up to 0.5% Ni, Nos. 1–6 up to 0.75, and No. 8 up to 1% Zn; all may contain up to 0.3% Mn and 0.1% Mg, and all but No. 7 up to 0.1% Sn, while No. 7 may contain up to 0.2% Sn. Other impurities up to 0.2% in Nos. 1–6 and up to 0.5% in No. 7 may be present. Only the composition is specified, the physical properties are given for information, and relate to die cast specimens, not those cut from die cast parts. Only one zinc base alloy is required to meet all service, production and cost requirements. For this, the purest of zinc (not over 0.02% total impurities, including Pb, Sn, Fe and Cd) is required, to produce stable castings. The 10-day water vapor aging test is considered most suitable for determining stability. The alloy, according to the proposed tentative specifications, is to contain 2½ to 3½% Cu, 3½ to 4½% Al, 0.02 to 0.10% Mg. The maximum impurities allowed are: Fe 0.10%; Pb 0.01%; Cd 0.005%; Sn 0.005%, other impurities 0.02%. Individual specimens on a round die cast specimen of specified dimensions must show 35,000 lbs./in.² tensile, ½% elongation in 2″ and Charpy impact, on a square specimen, of 4 ft.-lbs. The minimum average of 5 specimens must show 44,000, 2%, 6 ft.-lbs. After aging 10 days at 95° C. in a humidity cabinet free from wood or organic matter, the minima for the average of 5 are 30,000, ½% and ¾ ft.-lb. The average expansion in 5 castings thus aged must not exceed 0.0025 in. in any dimension less than one inch, or that expansion per inch in any larger dimension. There is appended a paper by Tobias. See abstract below. HWG(2)

Lead-Base and Tin-Base Alloys for Die Castings. F. J. TOBIAS (Newton Die Casting Corp.). Appendix I to Report of Committee B-6, A. S. T. M. *Preprint* for June 1931 meeting, *American Society for Testing Materials*, 3 pages.

Characteristic alloys of this class are:

	Sn	Cu	Sb	Pb	Tensile lbs./in.²	Elong. %	Brinell 20° C.	Brinell 100° C.	Sp. Gr.
Tin-base	85	7½	7½	..	10,000	1	30.2	15.3	7.53
Intermediate	60	3	11	26	7,800	1¼	27.7	10.2	7.98
Lead Base	5	..	15	5	8,000	1½	23.2	10.6	..
Pb-Sb	..	..	10	90	7,500	1	15.5	10.9	..

German experiments on an alloy of the lead-base type, but also containing 2½% Cu, and using 0.4% Ni instead of some of the Sb, are stated to have shown good hardness and tensile strength, but hard nickel-antimony compound crystals thrown against the die walls under pressure pitted the die. Some uses for alloys of each class are mentioned. Six references are cited. HWG(2)

Electrical-Heating, Electrical-Resistance and Electric-Furnace Alloys. Report of A .S. T. M. Committee B-4. D. HARVEY, Chairman. *Preprint* No. 20 for June 1931 meeting, *American Society for Testing Materials*. 18 pages.

Contains proposed tentative specifications for rolled or drawn 80 Ni, 20 Cr alloy (77–79 Ni; 19–20 Cr; maximum of other elements, Fe, 1½; Mn, 2½; C, 0.25; Si, 0.40; S, 0.03). This alloy is to be tagged with a yellow label. Similar specifications for 60 Ni, 15 Cr, 25 Fe are: Cr 14–18; Ni, minimum 57; maximum of other elements, Mn, 3; C, 0.25; Si, 0.40; S, 0.03; Fe, balance. This is to be tagged with red. A proposed tentative method for determining temperature-resistance constants is given. Work on life tests and accelerated life tests is in progress. A sub-committee is working on molding and foundry practice necessary to produce sound tension specimens for Ni-Cr-Fe cast alloys, on methods of test for thermal expansion, thermal conductivity and the relation of these properties to warpage. HWG(2)

Electrochemical Investigation on Aluminum and Alloys of Aluminum with Mercury. (Elektrochemische Untersuchungen an Aluminium und Legierungen von Aluminium mit Quecksilber.) H. GERDING (University of Amsterdam). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 151, Dec. 1930, pages 190–218.

No compound could be found in the system Al–Hg. A liquid and solid phase was established between 0.8 and 99.97 atomic % of Hg. The binary constitutional diagram Al–Hg was investigated by means of potential measurements of Al and its amalgams in solutions of acetyl-acetone. The potential difference between an amalgam with 2 phases and the extrapolated potential value of the "theoretical Al" amounts to 130 milli-volts. The normal potential value of this Al in an aqueous solution of aluminum chloride is −1.47 volts and −1.43 volts in an Al-sulphate solution. The electrochemical behavior of amalgams in acetyl-acetone is discussed and the formation of low-valence Al-ions is suggested. EF(2)

PROPERTIES OF FERROUS ALLOYS (3)

The Influence of the Cross Section of Ingots on the Mechanical Properties of Forged or Rolled Steel Bars. (Contribution a l'étude de l'influence de la section du lingot sur les proprietes mechaniques des barres forgees our lamines en acier.) A. PORTEVIN, E. PRETET & H. JOLIVET. *Revue de Métallurgie*, Vol. 28, Mar. 1931, pages 121–138.

Two ingots 40 and 21 cm. on the side were cast from several Ni-Cr heats and rolled according to the usual plant practice with the reduction of 4, 16 and 48 in the case of larger ingot and 4 and 12 for the smaller one. They were properly heat treated and studied under the microscope, macrographically and on a tensile strength machine. The irregularities due to crystallization in too large dendrites show their influence up to a certain minimum of deformation, which is largely dependent on the prominence of the dendritic segregations. In sound ingots the properties both transverse and longitudinal are not affected by the large reductions. They are detrimentally affected by impurities which might be present locally either as segregations, inclosed in certain areas of ingots, or in interdendritic spaces. Their presence is always dangerous, but particularly so in materials only slightly worked. The amount of deformation given cannot be used for prediction of the final properties. 18 tables and 29 photographs are given. JDG(3)

Tensile Properties of Cold-Rolled Bolts. (Festigkeitseigenschaften kaltgewalzter Schrauben.) W. REICHEL. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Apr. 11, 1931, pages 457–459.

The difference in the tensile properties of cut and rolled bolts is due only to the different method of threading. Both types are of equal value for all moderate stresses. The temperature occurring during the rolling of the thread is measured and its influence on the quality of the bolt is discussed. In general, the rolled bolt is superior to the cut bolt, especially in the refined state; the increase amounts, on an average, to 20%. At dynamical stresses, the rolled bolt is not quite as good as the cut bolt; the conditions under dynamic stresses have not yet, however, been sufficiently investigated. 15 references and microphotographs supplement the paper. Ha(3)

The Physical Properties of Fine Bolts. H. B. PULSIFER. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 273–312.

Paper read before the 12th Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion and is illustrated with 12 charts and 14 micrographs. The author presents a statistical study of the physical properties of bolts, Brinell, scleroscope, tensile strength, yield point and elongation. The spiral material of the thread outside the root diameter cuts down the elongation by stiffening the bolt giving a more abrupt fracture and wider scatter of results than would be obtained on a smooth test bar. Heat treating equipment, threading tools, sampling for test and the possibilities for improvements in the quality of bolts are discussed. WLC(3)

The Broad-Flanged Differdinger-Grey Steel Sections. (Die breitflanschigen Differdinger-Grey-Träger.) M. ROS. *Report* No. 52. *Eidgenössiche Materialprüfungsanstalt an der E. T. H. Zurich*, Aug. 1930, 34 pages.

Study of mechanical properties and allowable loads in Thomas steel of 0.06% C, 57,000 lbs./in.² tensile; 0.10% C, 64,000; 0.15% C, 71,000, made in certain broad-flanged sections. Segregation and heterogeneity were considered, and the necessity of finishing rolling above the critical point is emphasized. It is concluded that in properly made steel allowable stresses on these sections are:

Tensile Strength of Steel, lbs./in.²	Allowable Stress, lbs./in.² For Bridges	For Buildings
57,000	20,000	22,800
64,000	21,300	24,200
71,000	22,800	25,600

HWG(3)

Wrought Iron. Report of A. S. T. M. Committee A-2. H. W. FAUS, Chairman. *Preprint* No. 10 for June 1931 meeting, *American Society for Testing Materials*. 5 pages.

Slight changes in specification for stay-bolt, engine-bolt and other high-grade wrought iron bars are proposed. Grade C is to be termed B1 and its tensile requirements dropped, in 1¼ sq. in. or less section, from a maximum tensile of 54,000 to 53,000, over 1¼ sq. in. from 48,000–54,000 to 47,000–53,000, and reduction of area is dropped from 37 to 35%. On grade A, for flats, the reduction of area requirement is omitted. A sub-committee is planning for a symposium in 1932 on what constitutes "quality" in wrought iron. HWG(3)

Chromium-Manganese Steels. F. M. BECKET. *Heat Treating & Forging*, Vol. 16, June 1930, pages 750–754; *Iron Trade Review*, Vol. 86, May 15, 1930, pages 53–57; *Metal Stampings*, Vol. 3, June 1930, pages 543–544; *Rolling Mill Journal*, Vol. 4, May 1930, pages 219–220.

Abstract of a paper presented before the American Iron & Steel Institute in New York. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 900. MS(3)

Steel Castings as a Material of Construction. (Der Stahlguss als Baustoff.) A. OEHLER, with discussion by A. ENGLER, J. WEISS and M. ROS. *Schweizer Verband für die Materialprüfung der Technik*. Report No. 36 of the Eidgenossische Materialprüfungsanstalt (Report of discussion No. 11), Dec. 1929, 34 pages, 35 figures.

A résumé of the properties of large steel castings, discussing porosity, cracking, design to obviate these, properties of properly annealed steel of 0.15–0.20% C; 0.25–0.30% C, and 0 50–0.55% C, made in the open-hearth, the converter and the electric furnace. Some data on Ni-Cr steels are included. Gating is discussed. Short-time tensile and impact tests on cast steel up to 500° C. are given. The article covers such a broad field that it cannot be adequately abstracted. HWG(3)

Some Notes on Blue Brittleness. LELAND RUSSELL VAN WERT (Harvard University). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 404, 1931, 11 pages.

"Aging" of cold worked steel and "blue brittleness" are caused by precipitation of nitrides, oxides or carbides from supersaturated solid solutions. When steel is deformed at 200° or 300° C. the precipitation occurs immediately after deformation, thereby strengthening the steel as it is being tested. Torsion tests, in which load was automatically plotted against twist, were made at various temperatures. A stepped curve indicates alternate yielding followed by apparent elastic recovery, and is typical of steels in the blue brittle range. Pure (Yensen) iron at 300° C. showed small steps, indicating a small quantity of impurities. Izett steel at 300° C. gave even a smoother curve. Nitrided Armco iron gave a lightly stepped curve at 100° C., decidedly stepped curves at 200° and 300° C., and smooth curves above and below these temperatures. The same material when quenched from 575° C. gave stepped curves at room temperature, 100° and 200° C., but smooth curves at 300° and 400° C. Contains 11 references. JLG(3)

Nickel Cast Irons. (Ueber Nickelguss.) F. RENAUD. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 207; *Revue de la Fonderie Moderne*, Vol. 24, Nov. 25, 1930, pages 397–400.

Brief reference to a paper read at the International Congress for Mining, Metallurgy and Applied Geology, Liege, 1930. EF(3)

Stainless Steel. HARRY BREARLY. *Proceedings Society of Chemical Industry of Victoria*, Vol. 30, No. 6, 1930, pages 368–384.

The properties of stainless steel are briefly discussed. Experiments are described and observations detailed on the general problem of corrosion, particularly the part which stainless steel has had in the simplification of that study. WHB(3)

On Quench-Hardening Properties in Some Iron Alloys. T. MATSUSHITA & K. NAGAWASA. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*. Part 2, pages 163–178.

In English. Expansion, critical point and magnetic curves are shown for steels of 0.15–0.20% C and 1 to 17% Cr. Also magnetic and hardness curves for five practically carbon-free Fe-Cr alloys of 2.4 to 19.6% C; quenching from the γ region is alleged to produce hardening. The quenching temperatures actually used are not given. Similar tests were made on three alloys of 0.05 to 0.10% Si, 0.03 to 0.07% Mn, with 0.14% C and 1% V, 0.14% C and 3% Mo, and 0.07% C and 5% W. Tensile curves are given for different tempering temperatures. The V and Mo steels gave maxima of about 160,000 lbs./in.^{2} tensile. HWG(3)

The Development of Structural Steels. (Die Entwicklung der Baustahle.) O. PETERSEN. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 213–229.

The importance of high yield point in structural steels is discussed and the progress in producing such steel reviewed. The use of higher carbon brings poorer workability. The high Si structural steel is prone to have surface flaws and does not show as high a yield point as is desired in heavy sections without using an analysis that gives too high an ultimate strength. The next step was to a Cu-Cr steel of 0.15% C, 0.25% Si, 0.80% Mn, 0.50–0.80% Cu, 0.40% Cr. This is more uniform in properties in different sections, and can be finished at a lower temperature than the high Si steel, its critical range being 120° C. lower. It has a certain corrosion resistance due to its copper content. Shapes rolled from this give a yield point of 53,500 to 61,000 lbs./in.^{2}, tensile of 76,000–84,000 lbs./in.^{2} with 22–24% elongation and 45–50% reduction of area, with an impact of 10 to 12 mkg./cm.^{2} A variation of this steel may contain about 0.80% Cr, 0.30% Cu and 0.40% Si. Still another high yield point steel contains 0.15% C, 0.5% Si, 1.0 to 1.5% Mn and 0.3 to 0.6% Cu. In this, the Si may be lowered to 0.3% and around 0.15% Mo be used. Such steels, in various sections, give 51,500–61,000 lbs./in.^{2} yield, 76,500–87,500 lbs./in.^{2} tensile, 21 to 26% elongation and 45–36% reduction of area. HWG(3)

Operating Results and Fields of Application of the Recently Produced Different Kinds of Malleable Iron. (Betriebsergebnisse und Anwendungsgebiete der neuzeitlich hergestellten verschiedenen Tempergussarten.) RUD. STOTZ. *Giesserei-Zeitung und Giesserei*, Vol. 18, Jan. 2, 1931, pages 1–8.

In Europe, especially in Germany, the designation "malleable iron," contrary to American practice, does not designate a material with definite properties. The consumer must become acquainted with the peculiarities and difficulties of production in order to avoid trouble in working. In the future, the American practice will probably be followed to a greater extent in making black iron instead of the white chilled iron which was formerly made exclusively. Many new applications can be found for this product; it can often replace steel castings. The mechanical properties and metallurgical structure of the 2 kinds of malleable iron are described and test results are given. 6 references. Ha(3)

The Thermal and Electrical Conductivities of Cast Iron. J. W. DONALDSON. *Foundry Trade Journal*, Vol. 45, July 2, 1931, pages 5–6.

Refers to the work of Masumoto on the thermal and electrical conductivities of cast iron and then discusses the results of an investigation of these same properties, which was reported upon by him in 1928. The author concludes that the investigations which have so far been carried out justify the view that the thermal conductivity of gray cast iron varies from 0.110 to 0.140 and decreases with increase in temperature. The conductivity of white cast iron is considerably lower, varying from 0.030 to 0.080. The conductivities of both gray and white cast iron are affected by composition. Heat treatment also changes the behavior of the material. The relationship between thermal and electrical conductivity (Wiedmann and Franz law) holds with a fair degree of accuracy for white cast iron, but when graphitization occurs in either white or gray iron, the relationship is definitely altered. The article is illustrated by two tables and one diagram. OWE(3)

New Chromium Steel Contains Zirconium Sulphide. F. R. PALMER. *Steel*, Vol. 87, July 24, 1930, pages 50, 52, 54.

Addition of 0.4% ZrS_2 to a corrosion-resisting steel containing about 0.1% C and 14% Cr facilitates the machining, grinding and polishing of the steel practically to the extent of commercial screw-stock. This grade of steel is being machined at surface speeds up to 150 ft./min. The sulphide confers non-galling properties on the steel, reducing scratching, seizing and galling. The steel is being used for many purposes. Use of ZrS_2 in steel intended for sheets, plates or cold-rolled strip is not recommended because the steel does not respond well in these forms to deep drawing or forming operations. For best machining properties, steel containing ZrS_2 is heated thoroughly at 1350–1400° F. and cooled in air. This gives a Brinell hardness of about 187. If the steel is hardened by quenching in oil from 1850° F., and drawing at 700° F., it will have a yield-point of 92,500 lb./in.^{2}, tensile strength of 127,000 lb./in.^{2}, elongation in 2 in. of 16%, reduction in area of 38%, Brinell hardness of 255, and Izod impact value of 22 ft.-lb. The corrosion resistance of the steel is equal to that of the same analysis without ZrS_2. It remains practically scale free to about 1200° F. Samples which had an average Izod impact value of 40.6 ft.-lbs. had an average value of 42.7 ft.-lbs. after being held in a furnace at 800–1000° F. for 6 months. ZrS_2 exists in the steel as tiny particles uniformly distributed throughout the metal. MS(3)

The Magnetic Properties of Perminvars. (Ueber die magnetischen Eigenschaften der Perminvare.) H. KUEHLEWEIN. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 72–88.

The property of the perminvar materials—that is the constancy of the original permeability up to comparatively high magnetizing fields—which makes them so valuable in the construction of instruments—is not yet fully explained. The following results can be stated as certain: 1. The different shapes of the hysteresis loops of perminvars all form a continuous series; 2. An increase of the perminvar character in the Elmen perminvar range can be obtained either by a greater contents of cobalt or by annealing at higher temperature; 3. Hysteresis loops of perminvar character can be obtained only if the cooling after annealing goes on very slowly; 4. In the system iron-nickel-cobalt another perminvar range exists besides that of Elmen which lies very close to the iron-nickel series; 5. The more pronounced the perminvar character of an alloy is the more difficult it is to demagnetize it; some kinds can be demagnetized only by annealing. Numerous diagrams illustrate the paper; 7 References. Ha(3)

The Alloys of Beryllium with Iron. (Die Legierungen des Berylliums mit Eisen.) WILH. KROLL. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 33–34.

It had been observed that Be-Ni-Cr steels assume a greater hardness by very slow annealing at a temperature of at least 700–750° C. At this temperature, the aging obtains a maximum for these steels after having been quenched in oil from 1200° C. The aging of the beryllium steels is due, very likely, to the different solubility of Be in the γ-iron or α-iron. See also *Metals & Alloys*, Vol. 1, Feb. 1930, page 383. Ha(3)

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CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion of Cast Iron in City Soil. (Die Veränderungen des Gusseisens im Stadtgrund.) A. ROMWALTER. *Das Gas- und Wasserfach*, Vol. 73, Feb. 1930, pages 178–182.

Investigation on corroded cast iron pipes of under-ground piping. EF(4)

Method for Evaluating Results of Corrosion Tests. KARL PITSCHNER. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, page 974.

Abstract of paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 902. MS(4)

Protection of Iron Immersed in Aërated Salt Solutions and the Realization of an Evans' Cell. (Protection du fer plongé dans les solutions salines aerees et réalisation d'une pile Evans.) E. HERZOG & G. CHAUDRON. *Comptes Rendus*, Vol. 192, Apr. 7, 1931, pages 837–839.

The authors point out that a quantitative study of what may be termed an Evans' cell has not been made on account of the difficulty of forming cathodic or anodic surfaces on the entire electrodes. With the object of overcoming this difficulty they have designed a cell, a description of which is given in the paper. In this cell 2 plates of iron form the cathode and the anode, respectively. These plates are placed in compartments separated by a porous diaphragm, the plates prior to the experiment having been carefully polished to the same degree. The cathode is immersed in sodium hydroxide, the anode in ferric chloride or ferric sulphate. The cell is set in action by bubbling air around the cathode or by adding dilute oxygenated water to the hydroxide solution. The authors have noted that the potential rises slowly to about 0.15–0.20 volt and remains steady after several hours in the neighborhood of 0.4–0.43 volt. The experiments have shown that the current of such a cell is determined principally by the concentration of the oxygen in the neighborhood of the cathode, increasing with this concentration up to a certain limiting value. The authors have studied the effects of protection due to additions made to the corroding solution. They have found that a whole series of bodies: borates, phosphates, arsenates, bicarbonates, oxalates, citrates, acetates, etc., have a protective effect. This can be explained by the property which these bodies possess of forming such acid and basic compartments as are necessary for the building-up of a high voltage cell. A variety of potential-time curves are shown, these differing in their form according to the solution which is employed. An explanation is given of the various types of curve obtained. The authors point out that the device they have described enables a comparison to be made of the actions of seawater and sodium chloride solutions, the results obtained being in good accord with experiments made by measuring the loss of weight of iron after corrosion in these solutions. The article is illustrated by two curves. OWE(4)

Cadmium Plating vs. Corrosion-Fatigue. WILBER E. HARVEY. *Metal Industry*, N. Y., Vol. 29, Apr. 1931, page 175.

The following table lists the results obtained in testing cadmium plated steel:

	Engineering Experiment Station Cr-V Steel, lbs./in.²	Present Test 0.47% C Steel, lbs./in.²	Percentage Protection
Fatigue limit (air)	69,000	61,000	
Fatigue limit uncoated steel (water)	18,000	19,000	
Fatigue limit 0.0002″ Cd (water)	35,000		33.3
Fatigue limit 0.0004″ Cd (water)	42,000		47.0
Fatigue limit 0.00022″ Udylite (water)		45,000	62.0

PRK(4)

Solubility of Zinc in Sulfuric Acid. F. W. HARRIS. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, page 696.

Abstract of paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 688. MS(4)

On the Dissolution of Metals in Acids. (Ueber die Auflösung von Metallen in Säuren.) G. WALPERT (University of Münster). *Zeitschrift für physikalische Chemie*, Sec. A, Vol. 151, Dec. 1930, pages 219–233.

Experiments on Fe, Cr, Zn and Cd, the dissolution of which in acids after adding salts, acids and highly molecular materials is studied. The author concludes that his observations are based on the absorption phenomenon of "foreign matter" (Fremdstoffe). Owing to this, the primary reaction during the dissolution of metals must be an absorption of ions. EF(4)

Combating Wear of Tractor Parts. H. B. VEITH. *Machine Design*, Vol. 3, June 1931, pages 33–35.

Wear due to friction and the entrance of mud and water was efficiently overcome by means of a special lubricating system and washer at the end of the track roller shaft bearing box. Ha(4)

Corrosion and Heat Resistant Nickel-Copper-Chromium Cast Iron. J. S. VANICK & P. D. MERICA (International Nickel Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 923–942.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. A preliminary study of austenitic nickel-chromium cast irons led to the realization of their industrial possibilities and further study developed a valuable series of alloys containing 12–15% Ni, 5–7% Cu, 1.5–4% Cr, 1.0–1.5% Mn, Si 1.25% and total carbon 2.75% with low sulphur and phosphorus. These irons show good mechanical properties, satisfactory resistance to certain industrial corrosives and to heat. Various industrial applications are given and discussed. The thermal coefficient is 50% greater than for ordinary iron and has led to the use of this alloy for sleeves in automotive engines in connection with certain aluminum alloy pistons. WLC(4)

Corrosion Defects on Oil Tanks. (Korrosionsschäden an Oelbehältern.) TIBURTIUS. *Korrosion und Metallschutz*, Vol. 7, Mar. 1931, pages 49–53.

The author reports on two 10,000 m.³ oil storage tanks which failed in service due to corrosion. The drainage system of the surrounding pit did not work properly so that rain had free access to the bottom plate, which badly corroded and yielded when the storage tank was filled. The repair work on the tank is described at length and scientific laboratory tests are reported which indicate that coke and metal in the presence of water are liable to form "contact" and "concentration currents." EF(4)

Comparison of the Corrosion Resistance of Copper Steel and Plain Steel Railroad Ties. J. S. UNGER. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 93–95.

The 2 steels had the following composition:

	Copper Steel Ties	Plain Steel Ties
Carbon	0.23	0.22
Manganese	0.48	0.52
Phosphorus	0.018	0.017
Sulphur	0.049	0.047
Copper	0.25	...

After 9 yrs. in service, the average loss of 10 ties of each kind was 19.4 lbs. for the copper steel and 41.9 lbs. for the plain steel tie. The foot flange showed a much less reduced section in the copper steel ties. Ha(4)

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Effect of Antimony in Aluminum Alloys. (L'influenza dell'antimonio nelle leghe d'Alluminio.) A. W. BONARETTI. *Metalli Leggeri*, Vol. 1, Jan.-Feb., 1931, pages 29–52.

Discussion of results of corrosion tests in sea water for 180 days on various aluminum alloys—especially the "K. S. see-wasser" type, with Mn, Mg and Sb as alloying elements, compared with alloys containing 8% Si or 4% Cu. The last 2 alloys were destroyed by corrosion while several of the "K. S." type were not much affected. Tensile tests were made after corrosion, the actual figures not being given, the results being stated to be no change in elongation and a slight improvement in tensile strength for an alloy with 3% Mg, 3% Mn and 1% Sb. (The usual composition of the K. S. alloy is given as 1.4% Mn, 2% Mg, 0.7% Si, 0.2% Sb). Somewhat similar alloys without Mg did not behave quite as well. The data appear to be taken from the work of Baumeister. No alloy was tested in which the 3% each of Mg and Mn were used without Sb. No definite proof is presented to show whether Sb is really useful. The cast Mn-Mg-Sb alloy is said to have 20,000–28,000 lbs./in.^{2} tensile and 2 to 5% elongation. Wrought alloys 28,000–42,000 and 3 to 18%. It is stated that for wrought material, the Sb should be raised to about 2%, and the Mg lowered to about ½%. No corrosion tests are cited for such an alloy. High temperature tensile tests on the cast alloy of 25,000 tensile, 2% elongation showed little change to 250° C.; from 250° to 500° C., the strength fell to 8500 lbs./in.^{2}, and the elongation rose to 18%. Many photographs of large castings, mostly for marine use are shown. In only a couple of cases, is it specifically stated that the castings were of the 3% Mn, 3% Mg, 1% Sb alloy. Photos are shown of specimens of this, of silumin, of the "German alloy" (10% Zn, 2% Cu) and the "American alloy" (6% Cu) after 180 days in sea water, alone, and of all but silumin after 120 days, in contact with bronze or steel, to show that attack is least on the "KS" alloy. HWG(4)

The Puzzle of Corrosion. (Rätsel des Rosten.) DR. FREITAG. *Oberflächentechnik*, Vol. 7, Sept. 2, 1930, pages 162–163.

The familiar fact that iron from ancient times and the middle ages does not often show the least sign of rust or any other indication of corrosion is ascribed, in general, to a chance product of stainless material by certain additions. Several such examples are cited. Ha(4)

Some Factors Affecting the Corrosion of Buried Steel. F. L. BASSETT. *Gas Journal*, Vol. 194, Apr. 29, 1931, page 296; *Journal Society of Chemical Industry*, Vol. 50, May 8, 1931, pages 161–166T.

Gives discussion of paper presented before London Section of Society of Chemical Industry, April 13, 1931. MAB(4)

Anodically Oxidized Aluminum as a New Material for Electrical and Automobile Industry. (Anodisch Oxydiertes Aluminium als neuer Werkstoff für die Elektrotechnik und den Automobilbau.) KARL ALTMANNSBERGER. *Oberflächentechnik*, Vol. 8, May 5, 1931, page 101.

A new process for rendering aluminum or aluminum alloy sheets or shapes highly corrosion resistant was demonstrated at the International Automobile Show in Germany. The process was worked out by the United Aluminum Works and it differs materially from the English process. Thus, instead of using the pure 3% chromic acid as the electrolytic bath and employing progressively increasing voltage in the oxidation of aluminum, the German process applies a cold bath of arsenious acid, material involved as cathode. (By the English process, aluminum is used as the anode.) The first layer of aluminum oxide coating is produced by direct current and the final layer by alternating current. The coating produced also has high electric insulating power and is capable of absorbing the coloring substances permanently and uniformly. ER(4)

Corrosion of Iron and Steel. Report of A. S. T. M. Committee A-5. J. H. GIBBONEY, Chairman. *Preprint* No. 12 for June 1931 meeting, *American Society for Testing Materials*. 40 pages.

Contains reports of several sub-committees and accounts of work in progress. Among the projects in hand are; one looking toward specifications for plated coatings on iron and steel, in which 7000 specimens plated with Zn, Cd, Cu, Ni, Cr or combinations, are being prepared for outdoor exposure tests; one on methods of determining weight of coatings; one on the Preece test and stripping tests for Zn coatings; one on metal culverts, in which the specimens are to be put out in the spring of 1932; and one on embrittlement of galvanized structural steel on which experimental work is now active. Another major project is the study of methods of laboratory testing for prediction of service in the atmosphere, especially the SO_2-CO_2 simulated industrial atmosphere and the salt spray tests. Progress to date has not been encouraging, and it seems probable that if success is possible at all, it will be through the use of a flexible method in which the corroding agents are varied so as to duplicate different atmospheric conditions. Very valuable work by the sub-committee on total immersion tests is reported, in which material whose atmospheric corrosion in various localities is known by actual 5 years exposure, was subjected to acid immersion tests in 5 laboratories. The life was as shown below:

Material	Copper Content %	Life in Industrial Atmosphere near Pittsburgh Years	Life in Sea Coast Atmosphere Key West Years	Av. Life in 20% H_2SO_4 Hours
Y Open Hearth Steel	0.05	2	2⅔	20
R " " Iron	0.03	2	3⅔	480
V " " Iron	0.05	2⅓	3⅔	325
U " " Iron	0.09	2½	3⅔	950
W Wrought Iron	0.02	3	3⅔	6
N Open Hearth Iron	0.17	3	3⅔	970
S " " Steel	0.05	3¼	3⅔	35
T " " Iron	0.23	Over 5	3⅔	660
K " " Steel	0.27	Over 5	4½	275
C " " Steel	0.22	Over 5	Over 5	235

The acid immersion test does *not* predict atmospheric life. In the field tests of metallic coatings, the failure of galvanized sheets appears to be the inverse of the weight of coating. This test is still in the early stages. 26 pages of tables of data are given on exposure tests of coated and plated articles, like nipples, conduit, angles, bolts, wood screws, clamps, window frame sections and miscellaneous hardware, with hot dip Zn, hot dip Al, electric and gas sherardizing, electroplated Zn, Cd, Pb, etc., and some Amaloy and Parkerized coatings, all put on in regular commercial practice. These were exposed in the usual 5 localities differing in atmospheric conditions. The tests have continued for about 2 years, and the heavier coatings of hot dip Zn and Al are in general, still standing up. Many of the thin plated coatings have failed but the test is not yet far enough along for the committee to draw any conclusions. It merely presents the data. The abstractor has tried to figure out the relative performance of electroplated Zn and Cd of equal thickness from the data. The thickness is seldom the same on the two coatings in any one exposure, but where tentative conclusions can be guessed at, there would appear little to choose between the two, at least the alleged superiority of Cd is not at all evident. The same lots of Cd plated articles show better life in sea coast exposure than in industrial atmosphere exposure, on the whole. Parkerized articles in general have very poor life in sea coast exposure, but the coating appears to give at least a brief protection in industrial atmospheres. HWG(4)

Costly Rust of Metal Supply Can Be Prevented If Temperature Is Kept Above Dew Point In Storage Room. JOSEPH GESCHELIN. *Automotive Industries*, Vol. 64, Feb. 1931, pages 256–260.

Dew point temperature and not relative humidity is danger indicator in rusting of iron and steel stocks. Atmospheric corrosion may be eliminated by maintaining surface temperature somewhat above prevailing dew point temperature. Simple heating system with positive circulation throughout the entire stock will suffice. DTR(4)

Corrosion of Various Aluminium Alloys by Means of Salt-Spray and Intermittent Immersion Tester. H. ENDÔ & K. MIYAZAKI. *Kinzoku no Kenkyu*, Japan, Apr. 1931, pages 197–213.

The corrosion of various aluminum alloys such as duralumin, silumin, No. 12, L. 8, K (1.68% Mg, 0.38% Mn, 3.66% Cu, 7.16% Si), Q, Halmin (2.03% Cu, 1.28% Ni, 1.28% Fe), Al-Mg-Mn alloy and others was studied by means of salt-spray and intermittent immersion testers designed by H. Endo. Every test was done in a manner to suit as practical purposes as possible. Pure aluminum, Al-Mg-Mn alloys (1.1 to 1.3% Mg, 0.6 to 2.9% Mn), silumin and Mg-Mn-Si alloy (0.98% Mg, 1.90% Mn, 6.38% Si) were proved to be superior. KT(4)

Rust Protection of Sheet Iron Apparatus During Manufacture. (Rostschutz von Blechapparaten während der Verarbeitung.) A. DIETRICH *Korrosion und Metallschutz*, Vol. 7, Apr. 1931, page 90.

Note on precautions against rusting of fire extinguishers. EF(4)

Corrosion of Non-Ferrous Metals and Alloys. Report of A. S. T. M. Committee B-3. T. S. FULLER, Chairman. *Preprint* No. 19 for June, 1931 meeting, *American Society for Testing Materials*. 2 pages.

The use of the units, milligrams loss per square decimeter per day, and inches penetration per year, is recommended to A. S. T. M. and other corrosion investigators. Progress is being made on the outdoor exposure tests. A sub-committee is studying the behavior of stainless steel in contact with various non-ferrous metals, under corrosion. HWG(4)

On the Mechanism of the Oxidation of Iron. New Physico-Chemical Investigations of Rust. (Ueber der Mechanismus der Oxydation des Eisens. Neuzeitliche physiko-chemische Untersuchungen über den Rost.) C. CHAUDRON. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 206.

Brief reference to the paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. EF(4)

Corrosion and Corrosion Protection on Rolled Aluminum Alloys. (Korrosion und Korrosionsschutz von Aluminium-Walzlegierungen.) P. BRENNER. *Zeitschrift für Metallkunde*, Vol. 22, Dec. 1930, pages 420–422.

Discussion of paper with the same title in the October issue. See *Metals & Alloys*, Vol. 2, April 1930, page 78. (4)

Corrosion Resistant Alloys of the Stainless Type in Use and Fabrication. T. H. NELSON (Midvale Co). *Advance paper* for May 1931 meeting, *American Iron & Steel Institute*, 35 pages, 10 tables.

The compositions and mechanical properties of the plain chromium and the chromium-silicon steels are given, and their behavior on heating described. Carbide precipitation with consequent local impoverishment in chromium is described in relation to 18–8, and experimental evidence offered to substantiate the theory of impoverishment. To prevent reversion from the austenitic state due to impoverishment, it is logical to increase the chromium content. The danger is much less serious in 25% Cr, 10% Ni than in 18% Cr, 8% Ni, especially in welded structures to resist drastic corrosive conditions. Corrosive attack in the chemical industries may be of various types. In order to show how to select an alloy for a given chemical service, the behaviors of the pure metals Fe, Ni and Cr in HNO_3, HCl and H_2SO_4, and that of alloys with about 0.10% C and 18%, 24%, 34%, 43% Cr, with 10% Ni, 18% Cr; 10% Ni, 24% Cr; 19% Ni, 24% Cr; 24% Ni, 10% Cr and 21% Ni, 10% Cr, 4% Cu in 5% solutions of each of the 3 acids at 110° F. are given. In HNO_3, nickel does not materially aid in corrosion resistance, but it may help in fabrication or welding. In the oil industry, the addition of nickel has been found to reduce embrittlement at 800–950° F. In the paper pulp industry, the straight Cr alloys are not satisfactory as to corrosion resistance. Nickel is necessary, but the Cr content must be higher than the Ni content. The author advocates viewing corrosion resistance from the point of view of iron content and finds that, in general, if an alloy of 75% Fe, 25% Cr will serve, so will one of 20% Cr, and 5% Ni, or of 15% Cr, 10% Ni. Or, if an alloy of 65% Fe, 35% Ni behaves well, so will one of 25% Ni, 10% Cr or 20% Ni, 15% Cr. For any given corrosive service, either Cr or Ni should predominate, but as long as the one demanded by the corrosive conditions does predominate, there is a wide latitude in the ratio of Ni and Cr, the Fe remaining constant. Thus, the corrosion resistance needed may be retained, and the mechanical properties and workability of the alloy varied to meet the other conditions imposed. Comparison of alloys might well be made on the basis of iron content. A minimum of Cr or Ni, or Ni + Cr is needed to combat a given set of corrosive conditions. The ability to alter the Ni:Cr ratio and still preserve corrosion resistance helps in choosing an alloy for castings, as some compositions cast easier than others. Castings should be made from alloys that will cast well, not necessarily from those alloys that are preferable in wrought form. A higher Ni, higher Cr, higher C alloy is better from the foundryman's point of view. These corrosion principles can probably be adapted to high temperature corrosion, e. g., in SO_2 gas, present in many furnaces, an alloy in which Cr predominates over Ni is much superior to the reverse. Laboratory corrosion tests in simple solutions are useful only when they exactly reflect service conditions. For service in a complex solution, extrapolation from tests in simple solutions is often entirely erroneous. Tungsten is useful in Ni-Cr-Fe alloys, not only for heat resistance uses, but also, to resist erosion. HWG(4)

Influence of Arsenic on the Dezincing of Brass. (Einfluss des Arsens auf die Entzinkung des Messings.) GEORG MASING. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 35–56.

Two typically different kinds of corrosion can be distinguished in brass. The one is the general corrosion by which the brass as a whole is attacked either in spots or all over the surface. The second type of corrosion is often more dreaded, but theoretically more interesting: the dezincing, which consists in the gradual conversion of the brass into porous copper. It has been found that an important condition of dezincing is insufficient oxygen. The reduction of dissolved copper into metal is proportional to the amount of oxygen present. New tests have corroborated the experiments of Bengough and May in concluding that an addition of traces of arsenic to brass prevents dezincing entirely. This effect increases with an increase of 0.01–0.08% in the amount of As. The electro-chemical aspect of this corrosion is discussed and test results are described. 26 references are cited. See also "On the Dezincification of Brass," *Metals & Alloys*, Vol. 2, June 1931, page 118. Ha(4)

Protection of Tubing in Refrigerating Machines. (Rohrleitungsschutz für Kühlmaschinen.) MERZ. *Korrosion und Metallschutz*, Vol. 7, Mar. 1931, pages 61–62.

Material of pipes, operating scheme, requirements in regard to insulation and corrosion stability, prevention of corrosion attack. EF(4)

On the Corrosion of Molybdenum and Tungsten. (Ueber die Korrosion des Molybdäns und Wolframs.) S. L. MALOWAN. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 69–70.

After reviewing previous publications on the subject, the author presents his own investigations in which the corrosion attack in H_2O, distilled H_2O, KOH, NH_3, HCl and H_2SO_4 was determined colorimetrically. The corrosion resistance of tungsten was found to be remarkably superior to that corrosion stability of molybdenum. EF(4)

Corrosion of Aluminum Casting Alloys. (Korrosion von Aluminium-Gusslegierungen.) W. KRÖNIG. *Korrosion und Metallschutz*, Vol. 7, May 1931, pages 104–108.

Various Al casting alloys were tested for physical properties microstructure and corrosion resistance to sea-water. Alloys containing Cu as a principal addition displayed a poor corrosion resistance and in most cases showed the phenomenon of intercrystalline corrosion. Alloys with an addition of Mg and Mn proved to be superior to Cu bearing alloys. The Mg content, however, should not exceed 7 or 8% otherwise an interdendritic corrosion attack takes place. The writer strongly recommends an addition of Mn up to 1–1.5% which represents the maximum percentage due to the effective changes in physicals. Alloying Sb to Mg-Mn-Al alloys results in a further improvement of the highly anti-corrosive properties of these alloys. EF(4)

Behavior of Nitrided Special Steels against Copper Sulphate Solution. (Verhalten nitrierter Sonderstähle gegen Kupfersulfatlösungen.) O. NIEZOLDI. *Korrosion und Metallschutz*, Vol. 7, Mar. 1931, pages 53–54.

Paper deals with Fry's etching reagent and corrosion tests on nitrided steels, which did not prove to be stable in copper sulphate solutions. EF(4)

The Effect of Ammonium Chloride upon Metals in Industry. (Ueber die Wirkung des Salmiakes in der Metallindustrie.) GEORGE BUEHNER. *Oberflächentechnik*, Vol. 8, Feb. 3, 1931, page 21.

According to the investigations of K. A. Hoffmann, the ammonium chloride acts as ammonium acid and its attack upon metals must not be attributed to the dissociated HCl, as was hitherto taken for granted. This is verified by the ensuing facts. The dry ammonium chloride attacks the metals more effectively than dry HCl. The action of dry ammonium chloride on metals is accompanied by a more violent development of hydrogen than in the case of HCl. The reaction proceeds according to the following equation: $Me + NH_4Cl = NH_3MeCl + H$. Copper is more readily attacked by NH_4Cl than the less noble nickel. At elevated temperatures, the ammonium complex is more stable than HCl and, therefore, the rate of reaction is increased with rising temperature. ER(4)

Steamship Boiler Corrosion and Its Prevention by Improvement of the Boiler Water. (Die Korrosion in Schiffskesseln und ihre Bekämpfung durch Speisewasserpflege.) H. JANSSEN. *Korrosion und Metallschutz*, Vol. 7, May 1931, pages 108–111.

Takes up the prevention of boiler corrosion by purifying the boiler water and considers the main reactions and phenomena accounting for the corrosion of steamship boilers. Emphasizes former investigations of Tillmanns and Klarmann, Splitgerber, Parr and Straub. The paper was presented before the Reichsausschuss für Metallschutz, Kiel, 1930. EF(4)

Address and Report on Corrosion Papers of the Reichsausschuss für Metallschutz. (Begrüssungsansprache und Bericht über Korrosionsarbeiten des "Reichsausschusses für Metallschutz.") E. MAASS. *Korrosion und Metallschutz*, Vol. 7, May 1931, pages 97–104.

Lecture at the General Meeting of the Reichsausschuss für Metallschutz, Kiel, 1930. EF(4)

On the Corrosion Resistance of Copper Bearing Steels. (Ueber den Korrosionswiderstand gekupferter Baustähle.) W. MARZAHL & A. PUSCH. *Korrosion und Metallschutz*, Vol. 7, Feb. 1931, pages 34–39. 11 references.

Various copper bearing steels low in C, Si, Mn, Cr were submitted to corrosion tests in the laboratory and in the free atmosphere. The corrosion attack was studied by determination of the loss in weight and of the physical properties. The corrosion media applied in the laboratory were H_2SO_4, HCl, HCOOH, KOH, NaCl and H_2O. Both sets of experiments clearly proved the superiority of copper bearing steels in regard to corrosion resistance and thus fully confirmed recent results of other investigators along those lines. EF(4)

Influence of Stress on Corrosion. D. J. MCADAMS, JR. (Naval Engineering Experiment Station.) *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 417, 1931, 39 pages.

A continuation of the study of "corrosion-fatigue." The materials reported are Cr-Ni steel, Cr-V steel, stainless iron, Ni, Al bronze, Cu-Ni-Si alloy, Muntz metal, and nitralloy. Each experiment was in 2 stages, (1) corrosion with or without cyclic stress, and (2) a fatigue stage. The lowering of the endurance limit due to the corrosion stage was used as a measure of the "damage" due to corrosion. The results are plotted in the form of several different types of diagrams. Intercrystalline failure under stress is probably due to corrosion pitting. The conditions favoring such pitting are (1) high stress, (2) low cycle frequency, (3) slight intensity of corrosion and (4) very little accummulation of corrosion products. Contains 15 references. JLG(4)

Testing of Metals and Metal Alloys for Their Resistance to the Action of Salt Solutions. (Prüfung von Metallen und Metalllegierungen auf ihre Widerstandsfähigkeit gegen Einwirkung von Salzlaugen.) E. MAASS & W. WIEDERHOLT. (Chemisch-Technische Reichsanstalt.) *Korrosion und Metallschutz*, Vol. 6, Oct. 1930, pages 218–223; Nov. 1930, pages 241–250; Dec. 1930, pages 265–277.

The first installment represents a systematic research on the corrosion resistance of the following materials: Fe with 0.05% C and 0.08% C, electrolytic Cu, brass with 72.5% Cu, pure aluminum containing 0.22% Si and 0.27% Fe, aluminum alloy containing 3% Mn, 2.5% Mg, 0.5% Sb. The corrosion media are solutions of chlorides and sulphates of Na, K and Mg, i. e. Sylvinit, Carnallit, Glauber's salt and Bitter-salt. The following factors, which exert an influence upon the corrosion attack, were studied: degree of submersion (completely and partly), access of air, addition of oxygen, stirring of solution and temperature. The degree of corrosion attack was determined by weighing and by visual examination. Prevention of the access of air decreases the corrosion (0.6), while an increase by the following rates was noted: passing of oxygen: 2.5, stirring: 5.4, heating to 95–100° C.: 8.6. The second part refers to the influence of solid salts upon some 40 materials as Ni, Ni-Cu, Ni-Fe-Cr, electrolytic Cu, bronze, brass, 20/7 Ni-Cr-steel, various steel sheets, aluminum metal and one Al-alloy. Compositions are listed in a table. Length of testing time: one year. Salts used: potassium salts as mentioned above. Two sets of tests were carried out: (*a*) in a closed box filled with a moist atmosphere, (*b*) in a room with the access of the natural atmosphere varying in moisture. The test pieces were covered to a depth of 1 or 2 cm. with the various salts. The original paper must be consulted for the details of the 400 statements given. It might be mentioned that none of the materials tested proved to be absolutely corrosion resistant, and even the Cr-Ni steels were pitted, while a uniform and heavy corrosion attack was found to take place on the plain iron test pieces. Ni and to a smaller extent Ni-alloys, also displayed a fair corrosion stability, which is suspected to be lowered by Fe in the Ni-Fe-Cr alloys. Cu and bronze turned out favorably, too, and a pronounced difference was noted between α and β brass. Al was also locally attacked. The third part deals with solutions of the potassium salts. The testing conditions were as follows: (1) strips were suspended by a thread in a vessel closed by a ground-in stopper, (2) access of air and strips only partly submerged, in order to study the boundary line air/liquid, 250 cm.^{3}, (3) strips completely submerged, 300 cm.^{3}, (4) same as under (1) except addition of oxygen: 2–3 bubbles per min., (5) testing temperature: 90° C. automatically controlled, 400 cm.^{3}. Tests of one week duration and 1–4 months for conditions outlined under (1)–(4). Result of visual examination is given in numerous tables and losses in weight are graphically presented. Includes 5 illustrations and 14 tables. EF(4)

The Chemical Treatment of Metals and Alloys to Increase Their Corrosion Resistance. (Die Chemische Behandlung der Metalle und Legierungen zur Erhöhung der Korrosionsbeständigkeit.) E. COURNOT. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 205.

Summarizes a paper presented before the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. EF(4)

Radiators of Acid-Proof and Heat-Proof Materials. (Radiatoren aus säure- und hitzebeständigen Werkstoffen.) H. BINDER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Apr. 11, 1931, pages 465–466.

To avoid expensive tubes of high grade alloyed steels, radiators are made of sheets, which permits a greater flexibility to connect the individual parts of the radiator in parallel or series according to pressure. Chrome-nickel steels, all high heat-proof steels and sichromal, Monel metal and pure nickel can be used successfully as material for such radiators. In cases where acid-proof materials must be used, these materials are, in the end, cheaper than the usual common metals which require frequent renewal. Ha(4)

Recent Progress in Pipe Protection. HENRY W. HOUGH. *American Gas Journal*, Vol. 134, Apr. 1931, pages 40–42.

Reviews development of use of various methods and apparatus used in coating pipes. MAB(4)

A Laboratory Study of the Atmospheric Corrosion of Metals. Part 1. The Corrosion of Copper in Certain Synthetic Atmospheres, with Particular Reference to the Influence of Suphur Dioxide in Air of Various Relative Humidities. W. H. J. VERNON. *Transactions Faraday Society*, Vol. 27, June 1931, pages 255–277.

Experiments showed that copper changed very little in weight when in desiccated or water saturated purified air and in desiccated air containing as high as 10% SO_2. With the introduction of water vapor, attack of copper occurs in SO_2 atmospheres. There tends to be a minimum in rate of corrosion when the SO_2 content of air is 1%, the reaction product being normal copper sulphate. In atmospheres containing less than 1% SO_2 the copper sulphate is associated with excess base; if more than 1% SO_2 is present, there is excess sulphuric acid in the corrosion products. There exists a critical humidity between 63% and 75%, below which relative humidity has little effect on corrosion, and above which it has an enormous effect. CO_2 has little effect on corrosion in the presence of SO_2. In a humid atmosphere containing SO_2 the corrosion process is controlled by the catalytic oxidation of the SO_2, the surface condition of the metal affecting the corrosion rate. If the atmosphere contains H_2S, the corrosion process is controlled by gaseous diffusion through an initially formed film, the surface condition having no effect. Contains bibliography. PRK(4)

Rust and Rust Prevention. G. SODERBERG. *Monthly Review American Electroplaters' Society*, Vol. 18, May 1931, pages 15–28.

The origin of rusting as a process, in which first ferric oxide is formed and which is then further oxidized, is discussed in general and the influence of air and moisture in this corrosion is considered. The prevention of rusting by coating requires the greatest care because the envelope must be resistant toward chemicals and also against mechanical handling. The tendency of various metals to go into solution is described and the means of obtaining a rust-proof coating by proper treating of the articles before plating are discussed. Ha(4)

Short-Time Corrosion Tests. (Korrosionskurzprüfungen.) K. TAUSSIG. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Apr. 1931, pages 107–108.

Discusses previous methods for corrosion testing, the necessity for greatly decreasing the length of the test, and the methods used by Tödt, by Duffek, and by Duffek and Liebreich. MAB(4)

Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending. WALTER ROSENHAIN & A. J. MURPHY (National Physical Laboratory). *Iron & Steel Institute, Advance Copy* No. 16, May, 1931, 20 pages.

It has been observed that a type of failure occurs in boilers that differs both from the intercrystalline cracking occurring in the vicinity of rivet holes and from the action of the better known "fatigue." The failure occurs in parts that have probably been plastically deformed through a comparatively small number of cycles. In order to determine the effect of corrosive media on parts subjected to plastic deformation strips of boiler plate were bent in first one direction and then the other. The time between bends was usually 24 hours, but in some tests it was 5 min., 1 hr., or 48 hr. Failure was judged by the first evidence of cracking and by complete fracture. The number of bends to fracture varied from 25 to 41. Visible cracking and breakage were accelerated by tap water and brine. NaOH solution did not accelerate failure. The samples were usually bent in the solution and kept immersed during the rest period. No evidence of intercrystalline attack was observed on microscopic examination. Other experiments are in progress. Contains 3 references. JLG(4)

Corrosion and Corrosion Protection of Steel. (Korrosion und Korrosionsschutz von Stahl.) E. H. SCHULZ. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 179–194.

Summarizes the advantages of copper-bearing steels. HWG(4)

Novel Corrosion Resistant Protective Coatings for Iron and Steel Objects. (Neuartige korrosionshemmende Schutzüberzüge für Eisen- und Stahlwerkstücke.) H. REININGER. *Automobiltechnische Zeitschrift*, Vol. 34, Jan. 20, 1931, pages 27–29.

The production and texture of novel corrosion resistant coatings are described. Of these, the citoxide browning process is less known to American craftsmen. This process was invented by Dr. Uecker; by it, steel objects, after being immersed in a boiling aqueous solution of an oxidizing organic salt for 5–20 min., are covered with a tenaciously adhering ferrous-ferric oxide coating. The latter may fully compete with parkerized coating, except that it is more readily scratched through. The alumetizing process employed for producing heat resistant coatings is carried out in the following manner: The objects involved are coated with aluminum by a metal spray method. Then the coating is covered with soft flux and heated up to 1000° C. The microscopic examination discloses that in this way a continuous coherent coating is produced. Finally, a method is described for detection of uniformity of aluminum coating. The coated strip is polished without allowing it to cool; the display of blue color is observed, which does not extend to alumetized part of steel strip. ER(4)

Protective Coatings as Produced by Treating the Steels with Phosphates and Painting. (Rostschutz durch Phosphatbehandlung Phosphatierung des Eisens und Anstreich.) E. RACKWITZ. *Oberflächentechnik*, Vol. 8, Mar. 3, 1931, pages 53–56.

The resistance to corrosion of protective coatings on steel sheets as produced by Parker's and Bonderite process is increased still more by additional lacquering, oiling, etc. The author's tests show definitely that the painting of Parkerized sheets not only improves their surface appearance, but renders them more scratch-resistant, imparting to the protective coating also the property of adhering more tenaciously to the surface of steel. The lacquering of Parkerized sheets renders them also resistant to sea water corrosion attack. ER(4)

The Relation of the Moisture in Rust to the Critical Corrosion Humidity. W. S. PATTERSON & L. HEBBS. *Transactions Faraday Society*, Vol. 27, June 1931, pages 277–283.

Assuming that iron rust has a gel structure, the marked effect that rust has in accelerating corrosion can be explained. In humid atmospheres less than 40% saturated, water that is present in the rust is strongly adsorbed by the gel and is held by considerable force such that it is not free to further corrosion. If the humidity is above this critical humidity the gel fills with water and the forces that hold the water are lessened at the same time. Though there is but a small increase in the moisture content of the rust at the critical humidity, a much larger amount becomes available to further corrosion. Contains 9 references. PRK(4)

Chromium Cast Steels Resist Heat and Corrosion. H. D. PHILLIPS. *Foundry*, Vol. 59, Jan. 1, 1931, pages 65–69.

Corrosion-resistant metals usually fall into one of the following classes: (1) ferrites with little C; (2) martensite, non-malleable, being used after hardening; (3) austenite, solid solution alloys of Fe, Ni, Cr, C and Si. Steel may be strengthened by one or more of the alloying elements but the C content must be regulated. Cr in raising critical temperature necessitates higher temperature to relieve working strains. Ni dissolves in ferrite and increases hardness and strength without loss of ductility. When Ni and Cr are present together the good properties of each are enhanced by the other. Tabulates the analysis and physical properties of some alloy steels. Main source of trouble in feeding alloy steels in mold lies in the low heat conductivity as compared to ordinary steel. Cleaning alloy steel castings follows to a large extent the usual steel foundry practice. Martensitic Cr steel is more resistant to corrosion than one with pearlitic structure. VSP(4)

The Constitution of Scale. L. B. PFEIL. *Iron & Steel Institute, Advance Copy* No. 13, May 1931, 19 pages.

The portion of the Fe-O diagram from 70 to 78% Fe was studied by thermal and microscopic methods. Iron oxide was prepared by heating electrolytic iron in air, and samples of desired oxygen content were prepared by heating mixtures of high and low O-content oxides. An equilibrium diagram for the portion of the system studied is given. On slow cooling the ferrous phase decomposes into Fe and Fe_3O_4 at 575° C. The ferrous phase does not include the composition given by the formula FeO; its high iron limit is placed at 76.9% at all temperatures above 575° C., and its low iron limit varies from this composition at 575° C. to 75% Fe at the solidus. Under equilibrium conditions at room temperatures the components present are Fe + Fe_3O_4, Fe_3O_4, or Fe_3O_4 + Fe_2O_3. The outer layer of scale consists of Fe_2O_3, the middle layer of Fe_3O_4, and the inner layer of the decomposed ferrous phase. The inner layer is weak and brittle. In alloy steels the structure of the scale varies with the alloying element. Contains 12 references. JLG(4)

The Corrosion of the Tin-Plate Container by Food Products. T. H. MORRIS & J. M. BRYAN. Department of Scientific & Industrial Research, Food Investigation, Special Report No. 40, 1931. 29 figures, 73 references. Published by H. M. Stationery Office, London. Price 1 s. 6 d.

The problem of the corrosion of tin cans is characterized as the most fundamental with which the industry is confronted.

Lacquered cans give more trouble than unlacquered ones. The alleged relative immunity from corrosion troubles in England is not due to better lacquer or better tin plate, but to the lower temperatures and the type of fruits packed. Double-lacquering does not give immunity. Protective coatings are still imperfect. Glass and aluminum containers have their places, but there appears to be no effective substitute for the tin plate for many types of canning; so its corrosion problem has to be tackled.

The electrolytic theory, the effect of differential aeration, of pH, of depolarizers, and the solubility of tin in organic acids are briefly reviewed. The amount of tin in the foodstuffs, the effect of oxygen, the behavior of the Sn-Fe couple, and the effect of inhibitors are discussed from data in the literature. The effect of an inhibitor is due to adsorption.

Experimental work on corrosion in citric acid indicated that Armco iron was corroded only about half as fast as a 0.07% C, 0.38% Mn steel. If oxide films are removed, cold rolled steel corrodes more slowly in citric acid than hot rolled or annealed. In highly acid solutions oxygen has little effect; in weakly acid (pH 5) it accelerates corrosion greatly. Corrosion of tin is very rapid in presence of ferric citrate, or in the presence of iron and oxygen together.

Experimental work on the Sn-Fe couple showed total corrosion to decrease with increasing acidity, due to the greatly increased attack on the tin. Hydrogen evolution comes from the iron surface, not from the tin. The corrosion of the iron is decreased by contact with tin, while that of the tin is increased by the contact, but the total corrosion is much less than with iron in the absence of tin.

Iron is critically anodic to tin but soon becomes cathodic.

Some very pure sugars, which, however, contained traces of sulphide or sulphite, accelerated the corrosion of the steel, but some impure sugars acted as moderately effective inhibitors. Beet sugar will probably prove of greater value in canning than cane sugar. Sulphur compounds are harmful when acidity is high, but may be beneficial at low acidities. Gelatin appears to be a useful inhibitor at high acidities, but has no effect at low ones.

Lacquering is helpful in avoiding discoloration, due to combination of some coloring matters with tin, or to the formation of tin sulphide. Discoloration by iron sulphide is discussed.

Addition of citric acid to fruits of low acidity is helpful. Cherries in lacquered cans without citric acid produced 65 to 75% hydrogen swells in six to nine months, but when 0.3% citric acid was added the swells dropped to 0 to 5%. Care should be taken to use sugar free from sulphur. Use of beet sugar or of inhibitors of the agar type is suggested.—H. W. Gillett (4) B-

Corrosion Prevention. LESSITER C. MILBURN. *S. A. E. Journal*, Vol. 29, Aug. 1931, pages 148–157.

Means for protecting aluminum from corrosion is the principal topic discussed by the author. In this connection the theory of corrosion is analyzed and various protective coatings, such as paints, oils and greases, and the metallic, chemical and electrochemical types are commented on. Corrosion prevention, in the opinion of the author, is an obligation that rests primarily upon the aircraft manufacturer, who should provide a complete system of corrosion protection, either by design or manufacturing processes, which will be effective for several years and also supply a foundation on which the operator can overhaul the aircraft at the minimum expense. The German methods of protection against corrosion, as described by one of the discussers, do not require any heat-treatment of the metal by the manufacturer, the material being used as it comes from the mill and the sections being drawn through a set of rolls rather than through dies under tension. When heat-treating rivets to prevent corrosion, as outlined by another discusser, they should be quenched quickly. Proper heat-treatment of the metal, its correct preparation for painting and securing good adherence of the paint are necessary. The results obtained from Alclad metal in service are commented upon with satisfaction. Other topics brought out in the discussion include the possibility of rustless steel replacing duralumin; the use of zinc as a corrosion preventive in aircraft construction, the same as this metal is used in ship-building; and data on some of the new foreign alloys that have recently been developed for use in aircraft construction. WAT(4)

The Outdoor Corrosion of Zinc and the Effect of Rainfall and Atmospheric Pollution. W. S. PATTERSON. *Journal Society Chemical Industry*, Vol. 50, Apr. 3, 1931, pages 120–123T.

Specimens of pure Zn and Zn alloys were exposed to the atmosphere in the Clerkenwell area of London for several months. The rainfall was measured, corrosions rates determined by the loss in weight and the protective properties of the corrosion products determined. The alloys consisted of pure Zn containing 1.62% Sb, 1.90% Fe and 1.03% Pb respectively. Corrosion was most rapid in the winter months when pollution was greatest. The initial attack on Zn was acidic in character. The Zn-Sb alloy was most attacked and the Zn-Pb alloy the least. A certain amount of protection was obtained by the presence of corrosion products. The ultimate corrosion rate decreased due to the formation of basic salts and depended primarily upon the solubility of the corrosion products in polluted rain containing S compounds falling during the winter months. WHB(4)

The Effect of Artificial Aging upon the Resistance of Super-Duralumin to Corrosion by Sea-Water. K. L. MEISSNER. *Engineering*, Vol. 131, Mar. 20, 1931, pages 406–408.

Condensed from paper read before the Institute of Metals, Mar. 12, 1931. See *Metals & Alloys*, Vol. 2, July 1931, page 128. LFM(4)

A New Method for the Determination of Corrosion. (Ueber einen neuen Weg zur Korrosionsprüfung.) L. W. HAASE. *Chemische Fabrik*, Vol. 4, Apr. 15, 1931, pages 169–170; Apr. 22, 1931, pages 184–185.

Contains 4 references. The apparatus described is especially useful for determining the action of different kinds of water on water pipes. The constant renewal of water and control of oxygen is important in such tests. The water flows by gravity first into one beaker then overflows into another beaker through which oxygen is bubbled. A constant head gives a constant flow of 4–6 cc. per minute. This rate was found to give accurate results. Platinum electrodes are suspended in the beakers and the small electric current set up across them by the flow of the water is measured. It was found that the strength of this current depends on the corroding effect of the water. By using a slow rate of flow a protective coat is formed quickly and results can be obtained in 24 hours. Solutions differing little in chemical composition can be accurately tested. Results check with those obtained by other methods. CEM(4)

Deposition of Black Copper Oxide on Brass. HENRY L. KELLNER & HARRY A. CURTIS. *Industrial & Engineering Chemistry*, Vol. 22, Dec. 1930, pages 1321–1324.

The "black-bronzing" of brass is accomplished commercially by dipping the cleaned brass in a bath composed of copper carbonate and aqua ammonia. The bath corrodes the brass surface, and the black deposit, which consists of partially hydrated cupric oxide, is laid down over the roughened surface. The seemingly black and continuous deposit is curiously translucent when viewed under the microscope. MEH(4)

The Essential Factors of the Mechanism of Corrosion of Iron and Steel. T. FUJIHARA. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 25–38.

Includes discussion. Very sketchy tests are described, and about the usual conclusions drawn. Among the conclusions is that "dissolved iron, the soluble hydroxide of which is alkaline in nature, protects the metal," until neutralized by carbonic acid. HWG(4)

The Resistance of Copper-Nickel Steels to Sea Action. J. NEWTON FRIEND. *Iron & Steel Institute, Advance Copy* No. 7, 1931, 5 pages.

Steels containing as much as 3.8% Ni and 9.8% Cu with 0.2% C were melted in crucibles, cast and forged into square bars. The tensile properties are given. The bars were exposed for 2 years at half tide, and the effect of corrosion determined by appearance and loss of weight. Forged bars suffered more than annealed bars. The addition of Cu up to 3.7% increased the resistance of the steels to the alternate wet and dry conditions. The most resistant steel contained 1.16% Cu and 3.75% Ni. The effect of Cu plus Ni on microstructure is discussed. Ni greatly refines the structure as cast, but Cu does not. Contains 3 references. JLG(4)

Visual Inspection of A. G. A. Coatings. S. EWING. *American Gas Association Monthly*, Vol. 13, July 1931, pages 306–308.

471 pipe specimens with various types of coatings supposed to prevent corrosion in soil, buried in 9 locations for nine to twelve months were examined as to chemical attack upon the coating, mechanical attack by soil stresses, and condition of the pipe itself. The ratings are given in detail with symbols referring back to the descriptions of the coatings given in the A.G.A. Monthly for June 1930, page 269, so those interested may have the facts, but no conclusions are drawn. HWG(4)

The Action of Lime-Water on Aluminum. (Die Einwirkung von Kalkwasser auf Aluminiummetall.) GUNNAR ASSARSSON. *Zeitschrift für anorganische Chemie*, Vol. 191, 1930, pages 333–339.

The dissolution of commercial aluminum in lime-water varying in concentration between 0.045 and 0.125% calcium oxide was investigated at 0°, 17°, 22°, 40°, 50°, 65° and 90° C. The nature of the reaction products and their crystal form were determined. According to the concentration of the ime-water and the temperature, the following compounds or mixtures of them are formed: Al_2O_3, $4CaO,12H_2O$; Al_2O_3, $3CaO$, $12H_2O$; and Al_2O_3, $3CaO$, $6H_2O$. (4)

Oxygen Promotes Corrosion of Iron in Two Ways. H. ENDO & S. KANAZAWA. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 251–260, 17 references, 8 figures. In English.

Includes discussion. Oxygen promotes solution of iron in the first stage of corrosion and by oxidation of hydrogen and precipitation of ferrous ions, also promotes it in the second stage. HWG(4)

The Mechanism of the Suppression of Corrosion Velocity by Colloids. (Ueber den Mechanismus der Hemmung der Korrosionsgeschwindigkeit durch kolloide Stoffe.) W. BECK & F. v. HESSERT. *Zeitschrift für Electrochemie*, Vol. 37, Jan. 1931, pages 11–20.

The decrease in corrosion velocity of Fe in H_2O or strong acid solutions is due to the presence of hydrophilic colloids, and is dependent upon the type as well as the concentration of added colloid. The authors suggest the possibility of the formation of coagulation layers upon the surface of the metal, due to the action of the Fe ions upon the negatively charged particles of the hydrophilic colloid. The colloidal materials studied were agar, starch, silicic acid and gelatine, and the metals Armco, electrolytic, carbonyl and pure Fe. (4)

Corrosion Resistance of Aircraft Bracing Cables with Different End-Connections. M. ABRAHAM. *Wire & Wire Products*, Vol. 6, July 1931, pages 283–289.

Cables made from hot dipped zinc coated, and of cadmium plated carbon steel, and of uncoated steel of the 18 Cr, 8 Ni type, provided with sleeve fittings, splices, or soldered terminals, were exposed to salt spray test for 120 days and tested. The cadmium plated wires pulled out of the sleeve fittings. The others ran from no loss up to a loss of 7% of their initial strength. The zinc coated specimens did not pull out of the sleeves. The wire lost 10 to 15% of its strength. Coating with two coats of aluminum paint reduced the loss from 0 to 6%. Coating with linseed oil or a bituminous coating gave losses of 15 to 33%. The stainless wire lost from nothing up to 4% of its strength except when soldered with a $ZnCl_2$-HCl flux and failing to neutralize the flux remaining on the wire, which in one case brought about a loss of 13%. Splicing reduces the strength. From the strength and weight points of view, the soldered terminal is preferred. Preference is expressed for a cadmium coated cable with soldered connections and two coats of aluminum paint. HWG(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Structural Analogies of Binary Alloys of the Transition Elements with Zinc, Cadmium, and Aluminum. (Strukturanalogien der binären Legierungen von Uebergangselementen mit Zn, Cd and Al.) W. EKMAN. *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 12, Feb. 1931, pages 57–58.

The X-ray diagrams of binary alloys of zinc with iron, cobalt, nickel, rhodium, palladium, and platinum and of alloys of nickel with cadmium show that in all these systems a phase with the structure of γ-brass is capable of existence. In each case the region of homogeneity extends on either side of a composition corresponding with an atomic ratio of the transition element to the other component of 5:21. If the transition elements are assumed to possess zero valency, this composition represents a ratio of valency electrons to atoms of 21:13 (Westgren and Phragmen, A., 1929, 987). The iron-zinc phase is homogeneous between 19 and 23 atomic percent iron, the cobalt-zinc phase between 15 and 22 atomic percent cobalt and the nickel–zinc phase between 15 and 19 percent nickel. In the system cobalt–zinc a phase having the structure of β-manganese may be present and in the system cobalt–aluminum a phase similar to β-brass, the region of homogeneity of the latter phase including a mixture for which the ratio of valency electrons to atoms is 3:2. The formation of all the above phases from their constituent elements is accompanied by a considerable diminution in volume. (5a)

Virtual Images in Metallurgical Microscopy, Caused by Reflection in the Polished Surface. (Vid metallmikroskopi genom spegling uppträdende skenbilder.) C. BENEDICKS & H. LÖFQUIST. *Jernkontorets Annaler*, Vol. 115, June 1931, pages 310–313.

It is shown that in some cases two images of the same particle may be obtained by focussing above and below the surface under observation. This is due to reflection of the particle lying above the surface into the highly polished surface. The direct photograph gives the front side of the particle, while the reflection gives the back view. This effect makes it somewhat difficult to determine whether a given particle, for example, a slag inclusion, lies above or below the surface. HCD(5a)

Kinetic Measurement of a Transformation-Reaction in Solid Metals. (Kinetische Messung einer Umwandlungsreaktion in festen Metallen.) W. FRAENKEL & E. WACHSMUTH. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 219–229; 6 figs.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 906. HWG(5a)

Nature of the Nickel-Chromium Rustless Steels. ROBERT H. ABORN & EDGAR C. BAIN, *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 837–893.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion, six references to previous work and is illustrated by 14 micrographs and numerous diagrams. The effects of nickel, carbon and chromium on the instability of the austenitic state are discussed. The effect of cold work in development of ferrite is discussed. Magnetic measurements, microscopic observations, X-ray analysis, corrosion tests and hardness studies have been made to determine the course of these reactions, knowledge of which is essential to the manufacture and use of these alloys. WLC(5a)

The Equilibrium Diagram of Copper-Tin Alloys. M. HAMASUMI & S. NISHIGORI. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 211–214. In English.

Study of alloys in the region 10 to 40% Sn.

The δ phase is alleged to correspond to Cu_3Sn_8. The η phase corresponds to CuSn and transforms at 675° C. into γ with a linear expansion of 0.56%. There are three eutectoid transformations at 510°, 570°, and 630° C. corresponding to the change of α plus δ to β, δ plus η to ϵ, and β plus η to γ. Also two peritectic transformations at 577° and 625° C., corresponding to the δ to β plus ϵ, and the ϵ to β plus η changes. The transformation of δ and η into ϵ produces a linear expansion of 0.25%. The ϵ phase is indicated by resistance and expansion curves; also by metallographic examination of a quenched 33.6% Sn specimen. HWG(5a)

Equilibrium between Carbon and Its Oxides. (L'equilibre entre le carbone et ses oxydes.) P. E. HENRY. *Annales des Mines*, Series XII, Vol. 19, 1931, pages 5–25.

The work on equilibrium between C and its oxides by O. Boudouard, Read and Wheeler, Lewis and Randall, Schenck and his collaborators is comprehensively and critically reviewed. JDG(5a)

Equilibrium Diagrams of the Aluminum-Manganese, Copper–Manganese and Iron–Manganese Systems. T. ISHIWARA. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 143–155; *Science Reports Tohoku Imperial University*, Vol. 19, 1930, pages 499–519.

In English. Gives the diagrams and brief discussion. Since the diagrams are necessary for understanding of the discussion and the points brought out cannot be briefly abstracted, the original should be consulted. HWG(5a)

Equilibrium Diagram of the Ternary System of Tin, Lead and Antimony. K. IWASÉ & N. AOKI. *Kinzoku no Kenkyu*, May 1931, pages 253–267.

The equilibrium diagram of the ternary system Sn–Pb–Sb was determined by means of total and differential thermal analysis and by microscopic examination of well annealed specimen. The diagram has three non-variant points. The first corresponds to the β to β' transformation of the binary system of antimony and lead which was not discovered by Loebe and Campbell; the second to the eutectic crystallization of α, β and δ from the liquid which was considered by Loebe and Campbell as peritectic; the third to the pericto-eutectic reaction liquid $+ \beta \rightleftarrows \gamma + \delta$. There must be a maximum point in the binary eutectic curve joining the second and the third non-variant point and was found to be 245° at 10% Sb and 10% Sn. KT(5a)

On the Structure and Nature of Troostite. F. F. LUCAS. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 69–92; *Bell System Technical Journal*, Vol. 9, 1930, pages 101–120.

Evidence of high-magnification metallographic study indicates that primary nodular troostite is an aggregate of ferrite and carbide. HWG(5a)

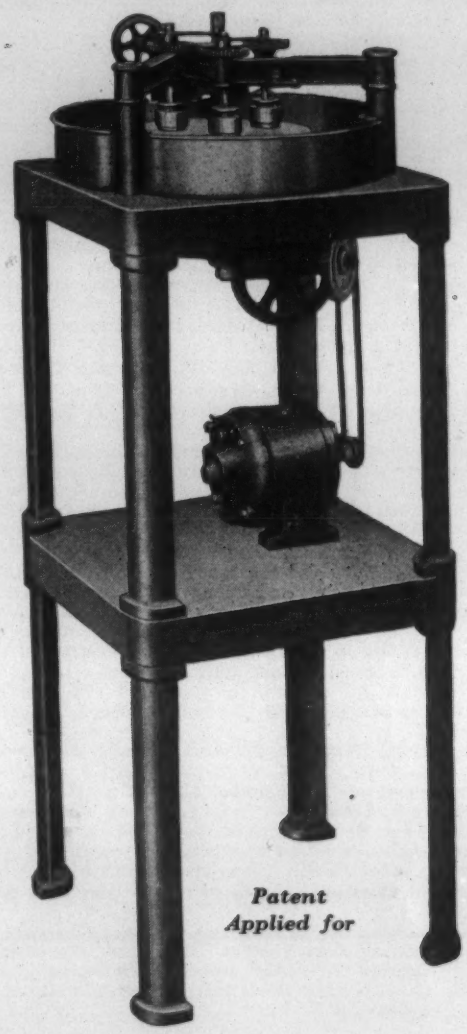
On the Microstructure of Pearlite. M. MIKAMI. *Kinzoku no Kenkyu*, July 1931, pages 350–353.

The present writer investigated whether the dark etched portion of the pearlite is cementite or ferrite by making the model of pearlite and came to the conclusion that the dark portion is not always cementite or ferrite, but in the most cases it is an oblique side of cementite relief. KT(5a)

On the Lowering of Critical Points in Molybdenum Steels. T. MURAKAMI & T. TAKEI. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 39–67; *Science Reports, Tohoku Imperial University*, Vol. 19, 1930, pages 175–207.

In English. Sixty-five alloys ranging from 0 to 70% Mo and 0 to 6% C were studied. The lowering curves are shown. The results do not accord with the theory of Swinden that lowering is due to solution of a molybdenum compound, but rather with the idea that it is a super-cooling effect. See also *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. HWG(5a)

The AMINCO Automatic Metallographic Polishing Machine



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The Solution of Cementite in Carbon Steel and the Influence of Heterogeneity. ERIK WALLDOW. *Engineering*, Vol. 113, Jan. 2, 1931, pages 27–30.

Condensed from paper used before the Iron and Steel Institute, Prague, Czechoslovakia, Sept. 15–20, 1930. See abstract in *Metals & Alloys*, Vol. 2, Jan. 1931, page 4. LFM(5a)

Decomposition of Austenite. H. S. VAN VLEET (Western Electric Co.) & CLAIR UPTHEGROVE (University of Michigan). *Metal Progress*, Vol. 18, Oct. 1930, pages 68–70.

The previously accepted facts on austenite retention and decomposition are summarized. Curves of decrease in density vs. drawing temperature and residual induction times coercive force vs. drawing temperature on quenched magnet steels both show distinct changes of slope at 300°, 525°, and 605° C. Differences between oil, water and 5% NaOH quenched specimens disappear at 300° C. showing that quenching stresses are relieved. The density increase between 300° and 525° C. is due primarily to martensite decomposition, while the practically constant density and magnetic properties between 525° and 600° show that the decomposition of austenite is counterbalancing that of martensite. While liquid air immersion decomposes austenite to martensite (although not completely in the 5.7% W magnet steels investigated) the results are different from those of tempering as shown by hardness tests and magnetic measurements. WHK(5a)

Theory of Arranged Mixed Phases. (Theorie der geordneten Mischphasen.) G. WAGNER & W. SCHOTTKY. *Zeitschrift für physikalische Chemie*, Vol. XI, Dec. 1930, pages 163–210, 35 references.

The problem of this scientific treatise is "to arrive at advanced theoretical deductions concerning the properties of systems with intermediate crystal phases by means of the application of certain pattern-like conceptions." The interest of the metallurgist is attracted by the discussion of the following systems (pages 199–210) 3 uranium-8 oxide (oxygen partial pressure during isothermal decomposition) γ'-phase of the Fe–N system. Fe_4N (equilibrium pressure of the gas phase between NH_3 and H_2) intermetallic compound in the Hg–Zn system (electromotoric forces) intermediate phase in the Au–Hg system (saturation pressure of Hg) and resistance concentration on diagram of the Au–Cu system. EF(5a)

Photomicrography with the 365mμ Mercury Arc Line. A. P. H. TRIVELLI & L. V. FOSTER. *Journal of the Optical Society of America*, Vol. 7, Feb. 1931, pages 124–131.

A joint communication from the research laboratories of the Eastman Kodak Company and from the scientific bureau of Bausch and Lomb Optical Company. Without doubt the highest resolution is secured by Kohler's ultra-violet photomicrographic outfit, but micrography with λ365mμ approaching this resolution has the following advantages over Kohler's apparatus: (1) A glass system can be used instead of the expensive quartz system. (2) The light source is a mercury arc lamp with filters, which is much simpler than the spectroscopic outfit used to obtain a high intensity cadmium line. (3) The focusing can be greatly simplified, as will be explained. One of the authors has overcome the difficulties previously experienced with commercial objectives. The arc spectrum of mercury in the near ultra-violet is discussed, as are light sources, objectives, immersion oils, microscopic objects, photographic materials and finally the results, which are illustrated by comparative photomicrographs. MFB(5a)

The Micro-Mechanical Study of Metals. (Etude Micro-mécanique des Métaux.) P. A. WELIKOFF, N. P. STCHAPOFF & W. F. LORENZ (Institut Scientifique Expérimental des Transports, Moscow). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 328–333, 14 micrographs.

The plastic deformation of small test pieces is examined microscopically in the course of the application of tension or compression. Micrographs and discussion are given of the slip lines in rail steel and in a 0.40 C, 1.0 Cr, 3½ Ni steel. HWG(5a)

Some Physico-Chemical Changes in So-Called Pearlitic Cast Irons. (Sur quelques modifications physico-chimiques des fontes dites perlitiques.) AUGUST LE THOMAS. *Bulletin de l'Association Technique de Fonderie*, Vol. 5, Feb. 1931, pages 46–58.

Physico-chemical phenomena accompanying heating and cooling of cast iron are exceedingly complicated. The use of constitutional diagram can only indicate the general trend of the phenomena because the number of the usual variables is too large and besides the inherent properties of the iron under which are grouped many badly understood characteristics inherent to different heats of the metal have almost as great an influence as the major characteristics. On cooling a typical pearlitic iron to 1150° just above it one obtains a mixture of 57% of liquid containing 4.2% C and a solid solution with about 1.4% C. Just below it the mass is solid and consists of crystals of solid solution and lamellae of graphite. As the solubility of carbon in solid solution is proportional to the temperature the lowering of it is accompanied with precipitation of graphite. It does not last long. At a certain temperature the conditions permitting the stable equilibrium (carbon and silicon content, the rate of cooling, etc.) become ineffective. Until this point the imaginary point of transformation was following a line on equilibrium diagram corresponding to the saturated solution of graphite. Reaching it the solid solution is enabled to cool without any changes in concentration. It now follows a vertical line on the diagram until it reaches the area of the solid solution. During this period the proportion of graphite both primary and secondary and of the solid solution remained the same. Depending on carbon concentration the metal at this point either deposits the excess of carbon along the lines roughly corresponding to the outlines of cells, or, if the temperature of the end of graphitic precipitation was low enough to lead to the formation of a solid solution with less than 0.9% C, to the precipitation of ferrite. An intermediary case is possible when the precipitation point corresponds to 0.9% C. The mechanism of changes produced by heat treatment was given in the previous article (A. Le Thomas, "Les alterations de la fonte aux hautes temperatures," *Bulletin de l'Association Technique de Fonderie*, Sept. 1929). During transformation below A_c a relatively fine mixture of ferrite and graphite is produced depending on the maximum temperature obtained in heating cycle. The final products of it are: graphite of solidification, both primary and secondary; graphite produced by decomposition of cementite, cementite not entirely decomposed; ferrite of the decomposition; pearlite more or less coalesced. Heating the metal above A_c one dissolves both the ferrite and decomposing cementite in the solid solution so that at the end only graphite and solid solution are present. On cooling to room temperature the same mixture as originally is liable to form. Using so-called pearlitic iron and a temperature decidedly above A_c one can see that the graphitization begins at about 1000° above which it is rather pronounced. Cooling does not show any changes corresponding to the solution of the precipitated graphite; though A_r point is well marked. When cooling takes place at the moment of equilibrium of graphite with solid solution it might produce: cementite and pearlite, ferrite and pearlite or only pearlite, which is largely dependent on the speed of cooling. Pearlitic irons produced by annealing of white irons often have a high strength. An iron with 2.8–3.2 C, 1.0–1.4 Si and about 0.7 Mn when cast produces a white iron but after heating to 950°, 1015° and 1070° followed by a furnace cooling has a hardness of 336, 223 and 179 kg./mm.², respectively, while its flexion increases from 0.19 to 0.48 mm. on bars 8 × 10 × 35 mm. JDG(5a)

Evidence That Metal Is Crystalline. E. E. THUM. *Metal Progress*, Vol. 19, May 1931, pages 75–80.

The author's paper is illustrated with a dozen photographs of dendrites and polyhedral grains structure. Metallographic and X-ray evidence of the crystalline character of metals is presented. WLC(5a)

A Brief Discussion of the Metallography of the Stainless Steels and Irons. EDGAR C. BAIN. *U. S. Steel Quarterly*, Vol. 1, No. 4, 1930, pages 79, 81, 83.

The chromium alloys possess the highest physical properties among the ductile and workable corrosion-resisting metals. This unique behavior extends to inertness in the presence of very active oxidizing environments such as nitric acid. They cannot be used in acid conditions not forming a resistant oxide surface, for instance in hydrochloric acid. The desirability of analyzing the conditions of the application, both as to temperature and as to the chemistry of the environment, cannot be too strongly advised, because then only the best suited metal for the purpose can be selected. This requires the coöperation of user and manufacturer. The carbon effect in the ferritic and austenitic alloys is briefly explained and illustrated by a few micrographs. Ha(5a)

Ghost Lines due to Crystalline Junctures. J. FLETCHER HARPER & HAROLD J. STEIN. *Metal Progress*, Vol. 20, Aug. 1931, pages 75–80.

This article with one which appeared in the July issue form a paper to be presented before the Boston Convention of American Society for Steel Treating, September 1931, and to be published later in greater detail with discussion. The authors discuss ghost lines arising from the segregation at the juncture of the columnar (outer) and the random (core) crystals of an ingot. A 30″ diameter shaft forged from a 48″ ingot was examined. A surface at a diameter of 17″ showed ghost streaks. Radial and tangential tensile and Charpy specimens taken as indicated in a diagram given showed lower ductility, Charpy value and flaws in the fractures while longitudinal test specimens were not affected in their values by this segregation. The occurrence of similar ghosts in two other shafts is described. WLC(5a)

The Sub-Crystalline Structure of Ferrite. C. O. BANNISTER & W. D. JONES (Liverpool University). *Iron & Steel Institute, Advance Copy* No. 2, 1931, 15 pages.

Work on the veining or sub-crystalline structure is reviewed. The structures found in wrought iron were studied, and it was concluded that 3 types of structure existed. Type I is similar to the cored structure associated with solid solutions, and probably represents a P segregation. It was found possible to produce this structure in a steel containing 0.098% P by means of short annealings above Ac_3. Type II consists of a deep veining of the ferrite crystals. Type III is a modification of type II, and its appearance is similar to etching pits. It is produced by the continued etching of material containing the type II structure. Both types II and III are probably manifestations of microscopical or sub-microscopical inclusions. Conditions causing and preventing veining are discussed. Contains 17 references. JLG(5a)

The Influence of Third Metals upon the Constitution of the Brasses. III. The Influence of Tin. (Der Einfluss von dritten Metallen auf die Konstitution der Messinglegierungen. III. Der Einfluss von Zinn.) O. BAUER & M. HANSEN. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 387–391; Dec. 1930, pages 405–411; Vol. 23, Jan. 1931, pages 19–22.

The ternary system Cu–Zn–Sn was studied in the composition range 70 to 50% Cu and 0 to 6% Sn thermally and micrographically. The results are expressed in constitution diagrams for alloys with constant Sn contents, 1.0, 2.0, 3.0 and 5.0%. Previous observations on the freezing ranges were confirmed. It was found that in a certain range the peritectic decomposition, α + melt = β, takes place, analogously to the relations in the Cu–Zn and Cu–Sn systems. The α and β solid solutions in the Cu–Zn and Cu–Sn systems are isomorphous. The peritectic temperature in the Cu–Zn system (905°) is increasingly depressed by the addition of Zn, and this depression is greatest for Cu-rich alloys. It amounts to 25°, 55° and 85° for alloys with 1, 2 and 3% Sn, respectively. The temperatures of the solubility changes and transformations in the solid state were determined by metallographic study on annealed and quenched specimens. The data obtained permit the construction of the full ternary system in the range studied. Falling temperature first results in the precipitation from the β-phase of the α- or the γ-ternary solid solution and then in the simultaneous precipitation of both α- and γ-phases. In one composition region the precipitation results in a complete absorption of the β-phase, that is, $\alpha + \gamma$ eutectoid is formed. The solubility curves bounding the $\alpha + \beta$ field are displaced toward Cu-rich concentrations with increasing Sn content and with rising temperature. The solubility of Sn in β-brass increases rapidly with temperature. At 400° 1.5% Sn is soluble in β-brass, while the α-phase saturated with Zn dissolves only 0.4% Sn at this temperature. More than 0.4 to 1.5% Sn (according to the Cu content) in alloys with 62 to 55% Cu leads the formation of brittle γ crystals besides α and β. The ternary α, β, γ and solid solutions in equilibrium from 400° to room temperature have the following compositions: α = 62.3% Cu, 0.4% Sn, 37.3% Zn; β = 55.0% Cu, 1.5% Sn, 43.5% Zn; γ = about 52% Cu, 8% Sn, 40% Zn. A note is appended giving the Brinell hardness of the ternary alloys investigated. RFM+EF(5a)

Study of High-Chromium, Low-Carbon Steel. ARTHUR PHILLIPS & RALPH W. BAKER. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 894–907.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The first section gives semi-quantitative data on the rate of grain growth in 28% chromium, 0.25% carbon steel. Correlation of factors of time and temperature with grain size are shown graphically. This steel reaches its maximum grain size in comparatively short periods of time at high temperature. The second section gives a microstructural study of 28% chromium steel, carbon 0.07 to 0.26. The gamma free limit is shown to be 0.10% carbon instead of 0.20% carbon as reported by previous investigators. WLC(5a)

Oxygen Containing Structure Elements in Iron-Carbon Alloys. (Om syrehaltiga strukturelement i Täckjarn.) CARL BENEDICKS. *Jernkontorets Annaler*, Vol. 115, Mar. 1931, pages 147–159.

By mixing molten pig iron with about 5% of magnetite, structure elements with a high content of oxygen were obtained, which could be observed microscopically without etching. On the one hand there is observed an oxy-pearlite, structurally identical with the oxy-pearlite discovered by the author in the iron found at Ovifak, Greenland formed by a process of natural reduction. This structure consists of alternating gray and white lamellae, either protruding from the grains of FeO or developed inside the latter. On the other hand there is also observed a solidification structure, containing idiomorphic cementite crystals, austentite with dissolved oxygen (oxy-austenite) and ferrous oxide. This structure seems to correspond to the ternary eutectic oxy-austenite–cementite–ferrous oxide. HCD(5a)

Metastable Equilibrium in Hypereutectoid Iron-Carbon Alloys. A. ALLEN BATES, D. E. LAWSON & H. A. SCHWARTZ. *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 659–672.

A paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The composition of the 2 phases in equilibrium in the metastable system between eutectoid and eutectic temperatures was determined by a planimetric study of 2 binary alloys differing in carbon. While the location of A_{cm} line is confirmed this work does not show the carbide phase above the eutectoid point to agree with the formula Fe_3C. The explanation is believed to be in a solution of γ-iron in the carbide phase. Preliminary observations on the possible solubility of carbon in iron carbide are made. WLC(5a)

Equilibrium Diagram of the Alloys of Calcium and Sodium. (Diagramme de solidification des alliages calcium-sodium.) E. RINCK. *Comptes Rendus*, Vol. 192, June 1, 1931, pages 1378–1381.

Using metals prepared by fractional distillation, the author has obtained a series of alloys of calcium and sodium of which the melting points, etc., have been observed. An equilibrium diagram based on these observations has been prepared—it is characterized by a field of partial miscibility in the liquid state. The concentrations of the conjugate liquid solutions were obtained by determining the isothermals for the reaction $Ca + 2NaCl = 2Na + CaCl_2$. The author stresses the value of this method of attacking the problem of determining the limits of the field of partial miscibility in alloy systems. OWE(5a)

Texture of Drawn Magnesium and Zinc Wires. (Ueber die Textur gezogener Magnesium- und Zinkdrähte.) E. SCHMID & WASSERMANN. *Mitteilungen der deutschem Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 87–89.

The investigations with these 2 hexagonal metals have proved that the crystal arrangement can be a tissue texture, spiral tissue texture and circular tissue texture while in other worked metals only the first one has been observed. Ha(5a)

Structure and Mechanical Properties of Cast Aluminum Alloys. (Structuur en vastheidseigenschappen van gegoten aluminium legeeringen.) P. SCHOENMAKER. *De Gieterij*, Vol. 4, Dec. 1930, pages 193–196.

A discussion of the microstructure and mechanical properties of an alloy containing 3.7% Cu and 7% Zn (a) in the sand-cast, (b) in the chill-cast, (c) in the annealed and (d) in the age-hardened state. Excellent etchings were obtained by polishing the samples with fine alumina and dipping the polished specimens in a very dilute solution of $FeCl_3$ in HCl. Rubbing from time to time with a piece of cotton moistened in the solution brings out the structure. HSvK(5a)

The Mathematics of Graphitization below the Solidus. H. A. SCHWARTZ. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol 34, *Mining & Metallurgy*, Part 2, pages 93–108.

See "Graphitization of Prequenched White Cast Iron," *Metals & Alloys*, Vol. 1, Nov. 1930, page 844. HWG(5a)

The Solid Solutions of the Copper–Silver System. D. STOCKDALE. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 127–157.

Includes discussion. See *Metals & Alloys*, Vol. 2, July 1931, page 128. (5a)

(Study on) Crystal Structure of Cementite. S. SHIMURA. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 223–225; *Proceedings Imperial Academy*, Tokyo, Vol 6, 1930, pages 269–271.

Using manganiferous cementite, and straight cementite (no details of purification given), it was found that Mn did not affect the crystal structure of cementite. The dimensions of the unit cell are given as a, 4.51; b, 5.04; c, 6.73 A. U. HWG(5a)

Alloys. Relation between the Colors and the Microstructures of Some Binary and Ternary Silver Alloys. SHUZO UENO. *Memoirs College of Science Kyoto Imperial University*, Series A, Vol. 13, No. 2, Mar. 1930, pages 141–147.

The relation between colors and micro-structure in some binary and ternary silver alloys is reported in the present paper. Details of arrangements for the experiment were described in the Sexagint, Kyoto, 1930. Curves showing reflection and intensity of reflection are shown for the binary alloys of Al, Ag and the ternary alloys of Al, Ag and Zn. WHB(5a)

Composition Limits of the Alpha-Gamma Loop in the Iron–Tungsten System. W. P. SYKES. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 428, Sept. 1931, 7 pages.

The γ-loop in Fe-W alloys was located by microscopic examination of samples quenched from the critical range. The 2 loops representing the boundaries of the γ-field and the γ-plus α-field extend to approximately 3 and 6.5% W, respectively. 4 references. JLG(5a)

Further Studies on Chromium-Nickel-Iron and Related Alloys. VSEVOLOD N. KRIVOBOK and others. *Preprint, American Society for Steel Treating*, Sept. 1931, 40 pages.

The present investigation deals with the theoretical considerations concerning the Cr-Ni-Fe-C constitutional diagram, with factors influencing the latter, with the so-called "decomposition" or "disintegration" of these alloys. Such decomposition is known to be accompanied by the precipitation of a constituent generally believed to consist of carbides. It is suggested that the precipitated constituent is not necessarily a carbide: in fact, in very low carbon alloys, the precipitated constituent is, undoubtedly, magnetic chromium-nickel ferrite. That is to say, the nature of a separating constituent is dependent upon the carbon content of the alloy. A phase change, from nonmagnetic to magnetic, accompanies decomposition. Whether decomposition precedes phase change or follows it is a matter of conjecture. The alloys were studied by means of magnetic analysis, microscopic observations, and corrosion tests. Alloys of extremely low carbon content, in which no carbide precipitation could take place, are described and shown to be immune from decomposition. When carbon is increased above a certain very small amount, the decomposition process is practically independent of the carbon content, and consequently there is very little reason to aim at the low carbon content in commercial alloys. A large number of Cr-Ni-Fe alloys with the addition of other elements (such as cobalt, molybdenum, silicon, copper) are described from the point of view of their behavior when subjected to decomposition treatment. It was found that the additions of certain elements prevent phase change, but do not suppress precipitation of a constituent, presumably, carbides. It was also shown that, contrary to ordinary Cr-Ni-Fe alloys, such precipitation has but little effect on some of the mechanical properties and resistance to corrosion in standard acid solutions, although the so-called copper sulphate test shows these alloys to be equally susceptible to attack. On the strength of this study, a suggestion is made that copper sulphate tests should be applied with intelligence. Changing the relative amounts of chromium and nickel in the alloy, as for example, using 12% Ni and 12% Cr instead of 18% Cr and 8% Ni, does not improve the alloy from the point of view of decomposition. The resistance to decomposition of alloys with special additions seems to be materially influenced by carbon content. The general indication is that the higher the carbon content, the larger must be the additions of those elements, which have been found to be beneficial. The influence of the treatment which the alloys received previous to the decomposition treatment is fully described. Original quenching temperature of the alloy exercises a very definite influence on decomposition. Alloys of different carbon content of the general "18–8" composition can be divided into three groups, each group with definite magnetic characteristics after decomposition treatment. Numerous curves showing the relationship betweendifferent properties of decomposed alloys are presented. WAT(5a)

Compounds of Copper–Tin and Other Systems. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 19, May 1931, pages 88–89.

A portion of the constitutional diagram Cu-Sn is reproduced and experiments on Cu-Sn compounds are discussed. WLC(5a)

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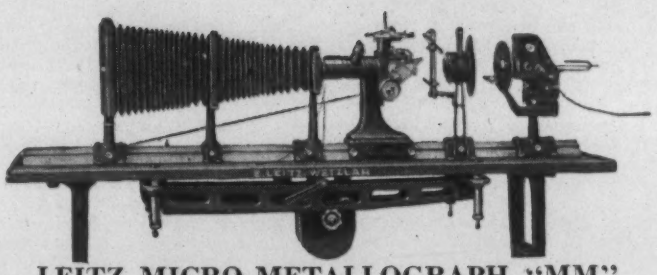

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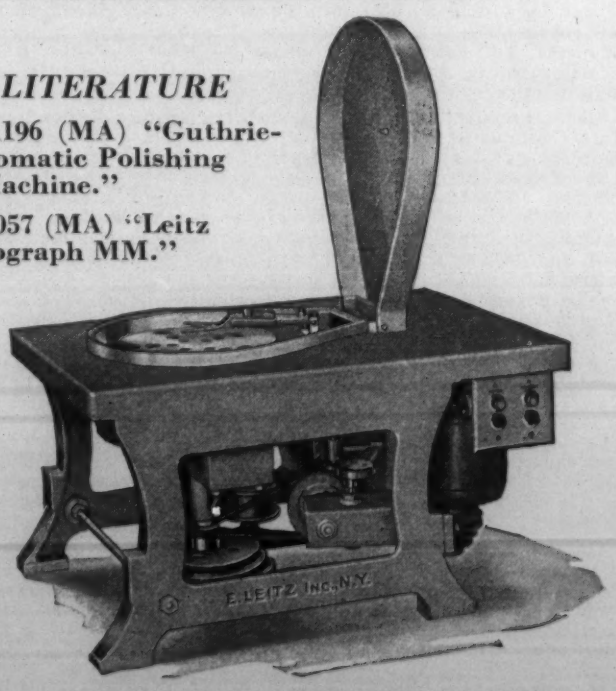

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The Change of Microstructure and Properties by Heating of High Manganese Austenitic Steel. TAKEJIRO MURAKAMI & MASAMITSU MIKAMI. *Tetsu to Hagane*, Vol. 17, Mar. 1931, pages 205–226.

A high manganese austenitic steel with 12.74% Mn and 1.19% C, obtained by quenching in water from 1000° C., was heated at several temperatures from 400° to 700°, for various lengths of time up to 50 hours, during which the change of microstructure, density, hardness and magnetization was studied. In microstructure, the following changes take place: (1) separation of carbide, (2) formation of troostite (nodulus), (3) formation of martensite, (4) formation of troostite (acicular) from martensite. The separation of carbide first takes place; as the heating temperature rises, the rate of separation increases, though the quantity of the carbide decreases, on account of an increase of the solubility. The formation of troostite (nodulus) and martensite take place in temperature ranges, 420–680°, and 420–600°, respectively; in the early stage of heating, the changes proceed most readily in the vicinity of 550°, and as the heating time increases, the temperature at which the change is maximum shifts gradually to the lower temperature. The acicular troostite is formed in the temperatures above 500° from the martensite. The density increases with the separation of carbide and the formation of troostite, but decreases with that of martensite. The hardness increases with the formation of carbide and martensite, but decreases with that of troostite. Magnetization increases with the formation of martensite and troostite, though no change is observable with the separation of carbide. From these facts the process of tempering of the austenite at several temperatures was inferred. The troostites, nodular and acicular, are formed by different methods, that is, the former is formed by the Ar change as the pearlite, while the latter is formed by tempering of martensite after long heating. According to Tammann's theory, the experimental results obtained were well explained. By means of the differential dilatometer, the Ac range was determined to be 530–680° C. TM(5a)

The Ternary System Aluminum–Magnesium–Silicon. (Sistema ternario, alluminio, magnesio, silico.) L. LOSANA. (Royal School of Engineering, Turin.) *La Metallurgia Italiana*, Vol. 23, May 1931, pages 367–382, 13 references, 23 figures.

The 3 binary systems are reviewed. These show that 4 ternary systems, Al–Si–Mg_2Si; Al–Mg_2Si–Al_3Mg_2; Al_3Mg_2–Mg_2Si–Al Mg_2; and Al_2Mg_2–Mg_2Si–Mg have to be considered. In the experimental work 99.79% Al, 99.74% Mg and 99.40% Si were used. Iron was the major impurity in all. 120 alloys were made up, melting in H_2, and thermal points determined. The solid solubility of Si and Mg in Al, and that of Si and Al in Mg were especially examined. 1.8% Si and 10% Mg are soluble in Al at the solidus temperatures, and the solubility line connecting these 2 points on the Al corner of the ternary diagram is approximately straight. The line for connecting the room temperature solubility points (about 0.4% Si and 3.2% Mg) is, however, convex toward the Al corner. On the Mg corner the solid solubility at solidus temperatures is plotted at about 0.8% Si and 7% Al (stated in the text as 1.5% and 5 to 6%), but the curve is very strongly convex toward the Mg corner. Similar convexity is shown in the room temperature solid solubility line, running from about 0.2% Si to about 2.5% Al. Isothermal projections are shown. Solid solubility of Al in Si is about 5% and of Mg in Si about 5.6% at solidus temperatures. Micrographic examination of some of the alloys is said to agree with the thermal data. Corroboratory expansion tests were also made. Al alloys with more than 20% Si and 1 to 2% Mg, or 12% Mg and 1% Si, are very brittle. "Runnability" spirals in a Mg alloy containing $6^3/_4$% Al and 0.31% Si at 750° C. averaged 35 cm. in length. Raising the Si to 0.78, 1.10 and 1.76% increased the length to 41, 45 and 54 cm. Tensile and hardness tests were made on a few of the alloys studied. HWG(5a)

Advances in Microscopy. F. F. LUCAS (Bell Telephone Laboratories). *First Communications of the New International Association for the Testing of Materials*, Group A, Zurich, 1930, pages 365–363.

Statement forecasting advances planned by Lucas, using ultra-violet light. HWG(5a)

Equilibria of Phases in Binary Systems with Continuous Solid Solutions. (Phasengleichgewichte in binären Systemen mit kontinuierlichen Mischkristallreihen). E. KORDES (University of Leipzig). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Jan. 1931, pages 161–196.

Empirical equations are given which refer to equilibria of phases between the crystalline and liquid state as well as between the various crystal modifications encountered in systems built up by continuous solid solutions. The same relations hold true for the change anisotrope⇌isotrope in case of mixtures of anisotrope liquids. The paper includes the discussion of the following systems: Fe–Ni, Cu–Pd, Cu–Au, Ni–Pd, Au–Pd, Au–Ni, Cu–Pd. EF(5a)

The Ternary Eutectic of Aluminum-Silicon-Beryllium Alloys. (Zur Frage des ternären Eutektikums der Al-Si-Be-Legierungen.) WILH. KROLL & ERNA JESS. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 25–28.

After rolling and thermal treatment, the ternary eutectic point was microscopically determined at 13.4% Si and 0.75% Be. Ha(5a)

Development in the Field of the Temperature-Dependent Crystal Structure Changes of Homogeneous Solid Metals. (Die Entwicklung auf dem Gebiete der temperaturbedingten Kristallstrukturänderungen von homogenenfesten Metallen.) H. ALTERTHUM. *Physikalische Zeitschrift*, Vol. 32, Dec. 1931, pages 305–306.

A summary of recent work on surface and working recrystallization of metals, theories of recrystallization, strengthening of metals, nucleus formation and growth, and crystal orientation. A bibliography of 105 references is given. (5a)

The Formation of Ferrite from Austenite. H. C. H. CARPENTER & J. M. ROBERTSON (Royal School of Mines). *Iron & Steel Institute, Advance Copy* No. 3, 1931, 35 pages.

A detailed study of the formation of ferrite on cooling is described. The variables were rate of cooling and carbon content. The behaviors of 3 steels, containing 0.10, 0.28 and 0.43% C, were described. Samples were prepared by cooling at 4 different rates through the transformation range. The shape and position of the ferrite grains depended both on the C content and the rate of cooling. A banded structure was formed in the slowly cooled 0.28% C steel. The mechanism of ferrite formation in reference to the equilibrium diagram and the results of the microscopic study is discussed in detail. JLG(5a)

On the Kinetics in Solid Solutions. (Ueber die Kinetik in Mischkristallen.) H. HANEMANN (Technische Hochschule, Berlin). *Zeitschrift für Metallkunde*, Vol. 22, Dec. 1930, page 404.

Short announcement of the "perfusion" phenomenon, which is different from diffusion. Represents certain kind of segregation taking place in solid solutions (C-steel, $\alpha + \beta$ brass). Exhaustive publication is under way. EF(5a)

Metallography. Report of A. S. T. M. Committee E4. C. H. DAVIS, Chairman. *Preprint* No. 24 for June 1931 meeting, *American Society for Testing Materials*, 2 pages.

"Kitten's ear" broadcloth, stocked by the Horne Co., Pittsburgh has been found generally satisfactory as a polishing cloth. Kersey cloth is used by some. Sulphur as a mounting medium has been recommended for some specimens. Magnification of 250× in place of 200× is recommended for the list of standard diameters. The 250× work should be done with a 8 mm. objective and a $7^1/_2$× or other suitable eyepiece. HWG(5a)

Structure & X-Ray Analysis (5b)

X-Ray Study of Some Tungsten Magnetic Steel Residues. W. A. WOOD (National Physical Laboratory). *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Oct. 1930, pages 659–667.

About 20 steels were examined. Identifies the carbide constituents of tungsten magnet steels from X-ray spectra of the residues. Constituents are tungsten carbide, mixed carbide (Fe_4W_2C), and a third compound probably due to the silicon content. No cementite is found. Tungsten carbide spacings are slightly smaller than the normal values. Suggests that in this and in the mixed carbide atomic replacement occurs. Chemical analysis of the residues as an indication of steel constituents is of doubtful value. X-ray analysis is reliable when controlled by photographs of the untreated steel. RHP(5b)

X-Ray Determination of the Solubility of Copper in Silver. (Röntgenographische Bestimmung der Löslichkeit von Kupfer in Silber.) N. AGEEW & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 50–55.

The lattice constant of silver, containing up to about 9% copper, quenched from 770–800° C., falls linearly from 4.078 to 4.029 A. U. On tempering at various temperatures, the constant is reduced. The following table shows the solubility of Cu in Ag and the lattice constants.

Draw Temp. Deg. C.	Lattice Constant A. U.	Solubility of Cu, Atomic %	Ageew & Sachs Weight %	Solubility by Hardness & Microstructure-Hansen
(0)	–	0.2(x)	0.1	–
(100)	–	0.3(x)	0.2	–
200	4.075_7	0.5	0.3	–
250	4.075_1	0.7	0.4	–
300	4.074_1	1.0	0.6	–
400	4.073_7	1.2	0.8	2.0 to 3.0
500	4.067_5	2.8	1.7	3.2
600	4.058_4	5.2	3.2	5.5
700	4.045_4	8.6	5.4	7.4
750	4.032_5	11.8	7.4	8.4
770	4.028_8	12.7	8.0	8.7
(779)	–	14.0(x)	9.7	9.0

(x) Extrapolated.

Electrical resistance measurements confirm the solubility limits. The curved solubility line, of course, shows the possibility of a heat-treatment of the type applied to duralumin. The solubility limits determined by X-ray methods give a curve similar to, but not identical with that determined by Hansen (See next abstract). HWG(5b)

The Hardness of Silver-Rich Copper-Silver Alloys (Determination of the Solubility of Copper in Silver with the Aid of Hardness Measurements). (Die Härte silberreicher Kupfer-Silberlegierungen (Bestimmung der Löslichkeit von Kupfer in Silber mit Hilfe von Härtemessungen).) M. HANSEN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 55–58; *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 186, 1930, pages 41–48.

By quenching Ag-Cu alloys from 750° C., tempering at various temperatures, and determining Brinell hardness, the knee in the hardness-curve plotted against the percentage of copper, shows the point at which the homogeneous solid solution breaks down into two solid solutions. Microscopic examination verified the solubility curve determined on the basis of hardness. The curve does not agree exactly with that determined by Ageew and Sachs using X-ray methods. The percentages scaled off from Hansen's curve, are given in the last column of the Ageew and Sachs' table (see preceding abstract). HWG(5b)

Rolling & Recrystallization Texture of Sheet Iron. (Walz- und Rekristallisations-textur von Eisenblech). G. KURDJUMOW & G. SACHS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 13, 1930, pages 67–70; *Zeitschrift für Physik*, Vol. 62, No. 9–10, 1930, pages 592–599.

A study of the crystal orientation and fibering of electrolytic iron and soft iron on rolling and on recrystallization was made by X-ray methods, utilizing the intensities of the reflections for the plotting of "pole-figures" after the suggestion of Wever (*Mitt. K. W. Inst. für Eisenforschung* Vol. 5, 1923, pages 69–77). The data on the rolling-texture do not agree with the simple explanation that the crystals arrange themselves with a cube surface in the rolling plane and a diagonal in the direction of rolling. The rolling texture is not entirely lost upon recrystallization and may even persist after the specimen has been heated into the austenitic field and slowly cooled. The article must be read with reference to the figures to be understood, and the original should be consulted. HWG(5b)

X-ray Investigations on the Age-Hardening of Duralumin at Room Temperature. (Ueber röntgenographische Untersuchungen der Kaltvergütung des Duralumins.) J. HENGSTENBERG & G. WASSERMANN (I. G. Farbenindustrie & Kaiser Wilhelm Institut für Metallforschung). *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 114–117; *Mitteilungen der deutschen Materialprüfungsant*, Sonderheft XVII, 1931, pages 34–38.

Investigations on duralumin proved that the interference lines of powder photographs are enlarging during the age hardening process at room temperatures. The intensities of the lines slightly increase while the intensities of the diffuse scattered radiation decrease. The authors conclude that, during the natural age hardening, an enrichment of Cu-atoms takes place to a very small extent within the aluminum space lattice. The precipitation of new crystals with the space lattice of copper ($CuAl_2$), i. e. of a heterogeneous phase, is denied. EF(5b)

The Lattice Constants of the Elements. WILLIAM HUME-ROTHERY. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Aug. 1930, pages 217–244.

Study of the measured lattice constants shows that in any sub-group of the periodic table, if the coördination number remains constant, the interatomic distance d is given by the relation $d/n = (1/aZ)x$, where n is the principal quantum number of the outermost shell of electrons remaining attached to the ions, Z is the atomic number, x is constant which is the same for groups with the same number of electrons in the outermost shell, and a is the second constant which in some groups may be connected with the valency. Following table shows the value of a and x.

Group	Elements	a	x
I A	Li, Na, K, Rb, Cs	0.0157	0.344
II A	Be, Mg, Ca, Sr, Ba	0.02265	0.35
IV A	C, Si, Ti, Zr, Hf	0.0465	0.345
V A	V, Ta	0.0628	0.368
VI A	Cr, Mo, W	0.0675	0.376
VIII A	Fe, Ru, Os	0.05998	0.404
VIII B	Co, Rh, Ir	0.05689	0.418
VIII C	Ni, Pd, Pt	0.05808	0.39
I B	Cu, Ag, Au	0.05105	0.393
IV B	Ge, Sn	0.0588	0.33
V B	As, Sb, Bi	0.04753	0.323
VI B	Se, Te	0.0944	0.21
O	Kr, Xe	0.02735	0.348

RHP(5b)

Collected Information on Atomic Structure. (Strukturbericht, 1913–1928.) P. P. Ewald & C. Hermann. Supplementary volume to the Zeitschrift für Kristallographie. Akademische Verlagsgesellschaft, Leipzig, 1931. Cloth, $6^1/_2 \times 9^1/_2$ inches, 818 pages. Price 47 RM.

This well-bound and well-indexed volume is a reference book of quantitative data on crystal structure, summarized and classified with great completeness for the period 1913–1926, with addenda for 1926–1928, not so fully classified but indexed thoroughly, and with some corrections from work up to February 1931. The compilation is a very serviceable one. All available data from X-ray crystal structure determinations are given, so that the lattice type, lattice constants and atomic spacing can be easily found. In the case of many elements and compounds, the lattice structure is shown in diagrams. The results of each worker are abstracted, with reference to the original, to show the sort of material studied, the method used, and the results obtained.

Elements, chemical compounds both mineral and artificial, alloys, and organic compounds are dealt with. Of the first 500 pages, about 400 are chiefly of value to the mineralogist and 100 to the metallurgist.

The next 100 deal with alloys and include 44 equilibrium diagrams that have been established or cleared up by X-ray methods. The next 125 deal with organic substances. About 30 pages of the material dealing with investigations from 1926 on are of metallurgical interest.

The material is so well summarized that it will seldom be necessary to refer to the original sources.

Data are piling up so fast that their summarizing by experts and their orderly arrangement is a very useful service. Books of this nature are becoming increasingly needed, especially in a field such as this where much of the important data appears in a variety of periodicals, not all of which are ordinarily available to those who might use the data. Current abstracts, if properly made by experts in the field, serve to make such data more readily available, but in any rapidly growing field of knowledge, the collection of the new data into books of this type every few years is essential. It saves the time of many workers, and those who have the ability and the patience to make such compilations do a real service to their science.

This is a useful type of book, and a good book of its type.—H. W. Gillett (5b)-B-

On the Cold Working of Platinum Wires and the Fibrous Texture Thereby Produced. Gilbert Greenwood. *Zeitschrift für Kristallographie*, Vol. 78, June 1931, pages 242–250.

The side of the unit cell of platinum was found to be 3.912 A. U. Cold working platinum wire gave it a fibrous structure in which the crystallites have their (111) direction parallel to the fiber axis. The fibrous texture is slightly conical in shape. PRK(5b)

Rolling and Recrystallization Structure of Regularly Surface-Centered Metals. III, IV, V. (Walz- und Rekristallisationstextur regulär- flächenzentrierter Metalle. III, IV, V.) V. Göler & G. Sachs. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 90–101.

A great many diffraction patterns show the relations of the changes going on in the structure in annealing sheets. The results of former investigations are mostly corroborated. The paper must be referred to as it can not well be given briefly. 44 references, supplement the article. See also *Metals & Alloys*, Vol. 1, Mar. 1930, page 427. Ha(5b)

The Refining of an Aluminum Alloy as Seen in the X-Ray Photograph. (Die Veredelung einer Aluminiumlegierungen im Röntgenbild.) V. Goeler & G. Sachs. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 33–43.

A relation between structure and refineability was sought on the basis of diffraction patterns taken with X-rays. It was found to be very complex. For instance, a refining directly after quenching or after aging for some time show quite different qualities. The principal condition for refining is to suppress the disintegration of the solid solution which is oversaturated at room temperature. 34 references. See "Appearance of Heat Treatment of Duralumin in the X-ray Photograph," *Metals & Alloys*, Vol. 1, Dec. 1929, page 285. Ha(5b)

The Size of the Unit Cell of Titanium Carbide. L. R. Brantley. *Zeitschrift für Kristallographie*, Vol. 77, May 1931, pages 505–506.

From powder photographs, it was found that the size of the unit cell for titanium carbide was 4.31 ± 0.02 A. U. PRK(5b)

Tensile Tests on Crystals of Copper and α-Brass. (Zugversuche an Kristallen aus Kupfer und α-Messing.) V. Goeler & G. Sachs. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 108–126.

The deformation changes during a tensile test in a gliding system are determined by X-rays. It can be stated that all crystals have a definite elastic limit; the effective compression tension at this limit increases rapidly at first and then more slowly. The individual results are reproduced in photographs, tables and diagrams. 50 references. Ha(5b)

Comparison Standards for the Powder Spectrum Method: NiO and CdO. C. J. Ksanda. *American Journal of Science*, Vol. 22, Aug. 1931, pages 131–138.

With an improved spectrographic powder method, the size of the unit cell of CdO and NiO has been redetermined with molybdenum radiation. The length of the edge of the unit cube is $a_0 = 4.689 \pm 0.003 \times 10^{-8}$ cm. for CdO, and $4.171 \pm 0.003 \times 10^{-8}$ cm. for NiO. The calculated density = 8.2 for CdO and 6.8 for NiO. Diffraction data from natural nickel oxide, bunsenite, agree with those of NiO, and from the character of the lines present, bunsenite has a face-centered cubic arrangement of 4 molecules of NiO. Determination of refractive index, microscopically by immersion, yielded $n = 2.44_{LI}$ for CdO, and $n = 2.37_{IL}$ for NiO. WAT(5b)

Recrystallization of Aluminum. I. Kenzo Tanaka. *Memoirs College of Science, Kyoto Imperial University*, Vol. 13, Series A, Mar. 1930, pages 117–125.

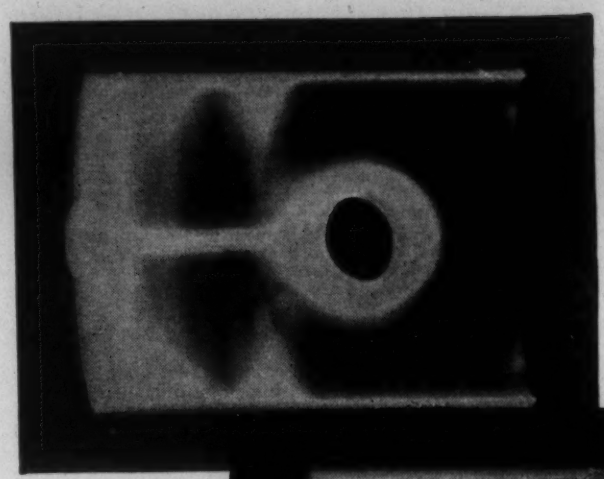
Crystals produced by recrystallation in slightly deformed single crystals of aluminum tend to have a definite orientation with reference to that of the mother crystal. The orientation is little affected by the direction of the stress applied before annealing, or the type of deformation produced by the stress. WHB(5b)

Elements of X-Ray Analysis by the Powder Method. L. W. Keehan. *Metal Progress*, Vol. 19, June 1931, pages 71–76.

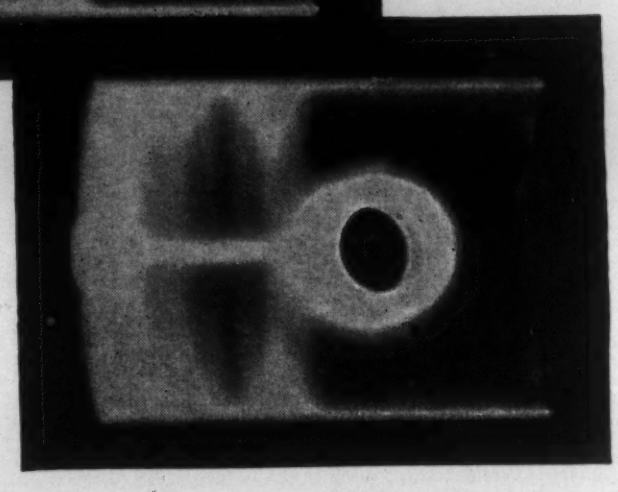
The history and advances in this method of X-ray study are described. Methods of reporting and describing results and experimental technique are briefly discussed. WLC(5b)

X-Ray Investigations on the Crystal Structure of Hardened Steel. Einar Oehman. *Iron & Steel Institute, Advance Copy* No. 12, May 1931, 19 pages.

An X-ray study of quenched steels confirmed the existence of the tetragonal phase whose axial ratio increased with increasing C content. From a consideration of these data it is concluded that martensite consists of a solid solution of C in body-centered iron. On effective quenching the tetragonal phase has the same composition as the parent austenite, as proved by the direct relationship between C content and space lattice dimensions. It appears probable that the C atoms dissolved in α-iron form a complex substitutional group in which 2 C atoms replace one iron atom. On tempering the tetragonal phase decomposes continuously with a progressive decrease in axial ratio. The causes of the hardness of martensite are discussed. Contains 47 references. JLG(5b)



Radiograph of aluminum alloy piston made soon after mold was put into operation.



View of piston after experimental work to determine a satisfactory method of operating the mold.

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The Optics of X-Rays. ARTHUR H. COMPTON. *Journal of the Optical Society of America*, Vol. 21, Feb. 1931, pages 75–89.

Author reviews early studies of the properties of X-rays and the theories advanced before Laue's discovery of crystal diffraction establishing the wave characteristics of these rays. After a review of the well-known recent researches, the paper then discusses less familiar aspects of the application of the optics of X-rays. First and perhaps most important comes a summary of recent elaboration of the methods of the Braggs, that has made possible a direct investigation of the arrangement of electrons in atoms, also studies of the structure of molecules of gases by means of diffraction patterns which is very much like the measurement of the average diameter of water drops in atmospheric haze from the size of rings around the moon on certain nights. In the case of monatomic gases, it is then pointed out how the study of X-ray diffraction has revealed *the form of the atom itself!* One of the current problems of X-ray optics is the counting of the number of molecules in a cubic centimeter of a crystal, and this method is explained in mathematical detail. The statement is made that the straightforward application of optical methods to X-ray diffraction enables us to obtain our most reliable standard for X-ray wave length. Equally important are the current researches to determine one of nature's fundamental constants, namely the ratio of the charge to the mass of the electron. This appears to have slightly different values according to the method by which this constant is measured. This is discussed in detail, including last year's work by Dr. Stauss in developing a precision method of determining X-ray refractive indices. MFB(5b)

Structural Analogies of Binary Alloys of Transition Elements with Zinc, Cadmium and Aluminum. (Strukturanalogieen der binären Legierungen von Uebergangselementen mit Zink, Kadmium und Aluminium.) W. EKMAN (University of Stockholm). *Zeitschrift für physikalische Chemie*, Section B, Vol. 12, Feb. 1931, pages 57–78, 14 tables, 18 references.

The crystal powder interference method was applied to investigate phases of the following systems: Fe–Zn, Co–Zn, Ni–Zn, Rh–Zn, Pt–Zn, Ni–Cd. The photograms obtained correspond to the interference image of γ brass. The phases were located at a valency electron concentration of approximately 21:13, presumably the transition elements are considered as zero valent. The Fe–Zn phase showed a homogeneity range between 19 and 23 atomic % Fe. The Co–Zn phases and the Ni–Zn phases are homogeneous between about 15–22 atomic % Co and 15–19 atomic % Ni. In the Co–Zn system, a phase was found, the crystal structure of which is identical with β-manganese. A phase analogous to β-brass was established in Co–Al alloys. The range of homogeneity of this phase includes a concentration in which the valency electron concentration amounts to 3:2 if Co is considered as zero valent. The volume per atom has been calculated for the phases investigated, proving that the formation of the phases is accompanied by a considerable contraction. EF(5b)

Laws Governing the Crystal Structure of Hydrides, Borides, Carbides and Nitrides of the Transition Elements. (Gesetzmässigkeiten im Kristallbau bei Hydriden, Boriden, Carbiden und Nitriden der Uebergangselements.) G. HÄGG (University of Stockholm). *Zeitschrift für physikalische Chemie*, Sec. B, Vol. 12, Feb. 1931, pages 33–56. 7 references.

Phases consisting of H, B, C, N and the transition elements display typical metallic properties in contrast with phases of these metalloids and other regular metals. If the ratio between the atom radius of the metalloid and the atom radius of the metal does not exceed 0.59, structures result which may be considered as imbeddings of metalloid atoms into the spaces of very simple metal space lattices. Phases with "imbedding structures" are mostly homogeneous if approaching the composition M_4X, M_2X, MX and MX_2, the peculiarities of which are discussed at length. The space lattice of all normal "imbedding phases" investigated, yielded 4 arrangements among which the face centered cubic lattice was the one most commonly encountered. This was the case with the MX phases, while the M_2X phase was usually crystallizing in the hexagonal close packed arrangement. The body centered cubic lattice and the simple hexagonal arrangement with the axial ratio 1 were found in only a few cases. In case of the normal "imbedding structures," the metalloid atoms are always arranged within the metal space lattice in such a manner as to yield a maximum coördination number. EF(5b)

Metallic Nitrides, Carbides, Borides and Hydrides. (Metallische Nitride, Karbide, Boride und Hydride.) GUNNAR HÄGG. *Metallwirtschaft*, Vol. 10, May 15, 1931, pages 387–390.

Some nitrides, carbides, borides and hydrides have metallic characteristics while others are decidedly non-metallic, some even gaseous. The metallic group contains metals belonging to the transition elements which have characteristic atomic structure. The metallic condition appears to be connected with the small dimensions of the metalloid atoms. These compounds are important as all metals used for alloying steel belong to the transition group. In each series of transition elements the combining power of the metalloid atoms with the metals decreases with rising atomic number of the metals. Some characteristics of some of the nitrides are described. Borides have not yet been thoroughly investigated. X-ray examination of nitrides, carbides and hydrides discloses that in most cases the metal atoms have a crystal lattice of very simple structure. One condition is that the metalloid atom is small compared to the metal atom. If the ratio of their radii is less than .59 the lattice is simple. Most of them are cubic close packed or hexagonal close packed. The atomic structure of some compounds is discussed in detail. CEM(5b)

X-Rays in Engineering Practice. V. E. PULLIN. *Engineering*, Vol. 130, Dec. 19, 1930, pages 785–788. Discussion, pages 779–780.

Condensed from paper read before the Institution of Mechanical Engineers, Dec. 12, 1930. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 794. LFM(5b)

Fine Structure of Zinc Lines in the Visible and the Ultra-Violet Regions. WALI MOHAMMAD & PREM NATH SHARMA. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Nov. 1930, pages 916–921.

Give results of experiments and calculations. Bibliography of 13 references. RHP(5b)

Quantitative Chemical Analysis by Means of Absorption of X-Rays. (Quantitative chemische Analyse mittels Absorption von Röntgenstrahlen.) N. H. MOXNES (University of Göttingen). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Feb. 1931, pages 380–408.

A new analytic method was developed based on the absorption of X-ray line-spectra. A description of a photographic-photogrametric method for measuring X-ray intensities is given. The practical utilization of the method is demonstrated by an analysis of Zn and Ni. EF(5b)

X-Ray Analysis of Cu-Mn Alloys. (Röntgenanalyse der Kupfer-Manganlegierungen.) ELIS PERSSON ((University of Stockholm). *Zeitschrift für physikalische Chemie*, Sec. B, Vol. 9, July 1930, pages 25–42.

By adding a few percent of Cu and by quenching, the γ-Mn-phase stable at high temperatures can be secured at room temperatures. The continuous transition of Cu into the γ-Mn-phase with rising Mn contents is discussed. By various thermal treatments, the border line of the different phases in the Mn–Cu constitutional system was established. A solubility of Cu in α and β Mn could not be proved by means of X-rays. The parameter of the Cu-phase increases with rising Mn contents from 3.608–3.74 A. U. up to 50 atomic % of Mn and then remains practically constant up to the border line, i. e., up to alloys containing 83 atomic % of Mn, presumably the alloys are quenched from high temperatures. The atomic volume of the 2 simply built phases seems to be continually changing. Over the whole concentration range, the formation of alloys built up by these phases is accompanied by a considerable expansion. EF(5b)

Non-Destructive Testing with Gamma Rays. ROBERT F. MEHL. *Iron Age*, Vol. 127, May 21, 1931, pages 1651–1655.

Of the 2 methods of non-destructive testing—magnetic, X-ray and gamma ray—the last mentioned has been studied and developed most recently. Gamma ray radiography is similar in principle to X-ray radiography. The differences between the 2 methods are: (1) differences of penetration and scattering of the ray resulting from shorter wave-length; and (2) differences in manipulation resulting from differing physical features of the equipment. The time of exposure is important. The outstanding feature of the method is its simplicity and convenience of operation. Radiographs of varying sections are possible. Includes results of tests on steel castings and welds. Taken from a paper read before the New York members of the American Society for Steel Treating and the American Welding Society. VSP(5b)

The X-Ray Test in Welding Technique. (Die Röntgenprüfung in der Schweisstechnik.) KANTNER. *Die Schmelzschweissung*, Vol. 9, Apr. 1931, page 88.

The advantages of testing of finished materials by X-ray methods is emphasized. In spite of the considerably higher investment costs for equipment sufficient to penetrate 2 to 3 inches of iron the operating expenses are less than those required for metallurgical or chemical tests; besides no material is destroyed, and what is more, this method is superior to magnetic tests, although neither method destroys the test piece, because it can also be applied to non-ferrous metals. Ha(5b)

X-Ray Test Equipment for Materials of the Deutsche Reichsbahngesellschaft in the Welding Laboratory of the Repair Shops Wittenberge. (Röntgenprüfanlagen für Werkstoffe der deutschen Reichsbahn-Gesellschaft in der Schweisstechnischen Versuchsabteilung des Reichsbahn-Ausbesserungswerkes Wittenberge.) C. KANTNER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Mar. 28, 1931, pages 399–400.

The equipment consists of a high-tension apparatus which can produce alternating current with one suppressed half-wave of 120,000 volts, constant direct current of 250,000 volts and pulsating direct current of 300,000 volts. The apparatus can be dismantled and mounted on railroad cars for tests at other places. Ha(5b)

General Principles. Physics and Technology of the X-ray Method. (Allgemeine Grundlagen. Physik und Technik des Röntgenverfahrens. Radiologische Praktika, XIV.) M. BRENZINGER, A. JANITSKY & E. WILHELMY. Georg Thieme, Leipzig, 1930. Cloth, 7 × 10 inches, 237 pages. Price 25.50 RM.

This book is volume XIV of an excellent series designed particularly for the medical applications of X-rays. This volume, however, is applicable to every branch of X-ray science. It is really a combination of three monographs as follows:

Part I. The Physical Principles of the X-ray Method by Wilhelmy.
Part II. X-ray Apparatus by Brenzinger and
Part III. X-ray and other Vacuum Tubes by Janitsky.

Under the first subject an extraordinarily clear and complete treatment is given of all fundamental principles including the laws of electric current. Previous knowledge of electricity and of X-rays is not assumed but the best possible development in minimum space has been the result of the painstaking effort of the author. It is doubtful if a better presentation could be made in 91 pages. Expecially interesting and valuable is the treatment of absorption and scattering of X-rays as applied to the understanding of filtration. It is doubtful if some of the roentgenologists know just why they are using sheets of copper and aluminum interposed between the X-ray tube and the patient being treated with X-rays. By a series of illustrations and excellent analogies the process of homogenizing a beam of X-rays characterized by many wave-lengths is clearly illustrated. The part devoted to X-ray apparatus is well illustrated and particularly interesting in that it presents very largely German practice and equipment designed particularly for medical diagnosis and therapy. The high tension equipment of American manufacturers is not overlooked, however, and there are several illustrations of various types of units manufactured in the United States. Part III. devoted to X-ray tubes, valve tubes, rectifiers and cathode ray tubes in the opinion of the reviewer is the best and most interesting treatment on modern X-ray tubes, particularly for medical purposes, which has yet appeared. The progress made in tube design and performance in Germany and Holland is really amazing. The very newest devices of all kinds are fully explained and illustrated for all types of tubes now in common use except those which are designed for diffraction analysis. The book would be a very welcome addition to the library of anyone interested in any branch of X-ray science. All three authors have written with the greatest care and in every possible way have tried to illustrate each point with practical examples. While, of course, German methods and practice are necessarily emphasized, the book is unusually broad in recognition of contributions of workers in other countries. The book is excellently printed and well bound and is free from errors.—G. L. Clark (5b)-B-

Structure of Rolled Metals and Its Change due to Amount of Reduction. (Die Walztextur und ihre Veränderung in Abhängigkeit vom Grade der Verformung.) E. F. BACHMETEW. *Metallwirtschaft*, Vol. 10, June 5, 1931, pages 451–454.

Contains 9 references. Sheet aluminum and duralumin were cold rolled with various degrees of reduction and tensile tests and X-ray examinations were made. It was found that with reduction in thickness up to 30% no crystal orientation takes place. The "maximum strength" (quotient of maximum load and cross section at the moment of the maximum load during tensile test) remains the same. During the second stage of rolling, up to about 70% reduction, an increasing tendency towards orientation and growth of the crystallites takes place. This is the transition period between quasi-isotropy and anisotropy. This was determined from the appearance of the Debye-Scherrer rings. During this stage the maximum strength increases with the amount of reduction. In the third stage, over 70% reduction, the highest degree of anisotropy, has been reached, and further reduction causes an entire change in the orientation. The orientation axis proceeds in the direction of the (111) axis. The maximum strength increases rapidly during this stage. CEM(5b)

X-Ray Investigation of Iron and Manganese Alloys. A. OSAWA. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 293–305.

In English. Five phases are found in the Fe–Mn system—body centered from 92 to 100% iron, a hexagonal phase from 78 to 84% Fe, α and β manganese from 0 to 35% iron (at a sufficiently high temperature) and a solid solution of γ-iron and γ-manganese throughout the whole series. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 845. HWG(5b)

X-Ray Investigation of Certain Nickel Steels of Low Thermal Expansion. G. PHRAGMÉN. *Iron & Steel Institute, Advance Copy* No. 14, May 1931, 10 pages.

Precise measurements of the lattice dimensions of Ni-Fe alloys at various temperatures proved that the low coefficient of expansion of alloys containing about 36% Ni is a property of the face-centered cubic lattice of this composition, and is therefore not due to a 2-phase reaction. The study was made on alloy strips, which could be heated electrically, in a camera utilizing the Bragg focusing principle. At room temperature the maximum lattice parameter occurs in alloys containing about 38% Ni. It is suggested that the specific volume anomaly may be connected with the anomaly of expansion. Contains 6 references. JLG(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

The Measurement of Large Brinell Impressions in Steel Rails. H. H. MORGAN & J. R. MOONEY (Robt. W. Hunt Co.). *Preprint* No. 36 for June 1931 meeting, *American Society for Testing Materials*, 6 pages.

In making tee and girder rails, hardness tests are made with a 3/4" (19 mm.) ball and 100,000 lb. load. Girder rails are accepted or rejected on this basis. On account of the bulging about the impression, neither diameter nor depth measurements give true Brinell figures, the diameter figures being the closer, but they are erratic. A special gage was designed and is described which measures the depth from the top of the piled-up ridge so that point in the impression where the diameter is 0.436". To this distance the gage, by a zero setting, automatically adds 0.07". The gage is checked upon a standard calibration block. The Hunt gage gives Brinell's averaging within one point of the figure obtained with the standard ball, and the average error is only about 1 1/2%. HWG(6)

Properties and Mechanics of Materials. P. G. LAURSON & W. J. COX. Wiley & Sons, New York, 1931. Cloth, 6 × 9 inches, 353 pages. Price $3.50.

This is an elementary text-book for sophomore students, and not a reference book. It refers to mechanical testing only enough to let the student understand what the data from a tensile test refer to. Fatigue and impact testing are passed over with scarcely more than the mention that they exist.

The description of the properties of metallic materials of engineering is decidedly elementary. From the pedagogic point of view the relative emphasis is probably about right, but readers other than sophomores will not find much they do not already know in the metallurgical part of the book.

The mechanics part is also elementary, but well chosen for its purpose. In reference to building codes, etc., the latest ones are used, and in general the treatment is up to date.

It seems unfortunate that in reference to key-ways on shafting there is no hint that the stress due to the notch is greater than that indicated by the normal formulas. The possibility of failure from local stress, corrosion, fatigue or wear, and the high temperature properties of metals are either not mentioned at all or dismissed with a word.

The book sets out to be a good elementary text-book. It is just that and that only.—H. W. Gillett (6)-B-

Tests on Cast-Iron Specimens of Various Diameters. J. T. MACKENZIE. Appendix II to Report of Committee A3, A. S. T. M. in *Preprint* No. 11, for June 1931 meeting, *American Society for Testing Materials*. 6 pages.

Gives breaking load, modulus of rupture, deflection and modulus of elasticity on 7/8" diameter, 12" span; 1.20" diameter, 18" span; 2.20" diameter; 18 and 24" span, and Brinells on the 3 sizes, for 36 heats of cupola and electric furnace cast iron. 12 heats contained around 2% Ni, 1/2% Cr, and two, around 12 1/2% Ni, 2% Cr. It was hoped that the properties of the 7/8" and 2.2" bars could be predicted from those of the 1.20" bar, but this was found not to be the case. The author advocates the use of 3 sizes of test bars. HWG(6)

Brown-Lipe-Chapin Gear Testing Fixtures. FRED C. RAAB. *Metal Progress*, Vol. 19, Mar. 1931, pages 47–52.

While service in the car is recognized as the final criterion of the worth of differential gears, short time tests are in use by gear makers for determining the relative merits of different steels and different heat treatment of the same steel for gears. This sort of tests as used by Brown-Lipe-Chapin are described and discussed. Limited application of the tests and careful interpretation are essential in their use for developing better gears. WLC(6)

Study of Broaches with Different Cutting Angles and Breadth of Face. (Untersuchungen von Raumnadeln mit verschiedenen Schnittwinkeln und Fasenbreiten.) A. MANN (Tech. Hochschule, Dresden). *Berichte über betriebswissenschaftliche Arbeiten* (V. D. I. Verlag, Berlin), Vol. 2, 1929, pages 35–51. 51 figures, 200 references.

Study of power consumption, best tool angles, type of chip formed and effect of lubricants in broaching cast iron, steel of 84,000 and of 65,000 lbs./in.² tensile, a 60 1/2% Cu, 1% Pb brass of 65,000 tensile, another of the manganese bronze type of 59,000 tensile and also drawn down to 69,000 tensile. Results are shown in many complex diagrams. HWG(6)

The Friction of Wire Cables In Clamps. (Die Reibung von Drahtseilen in Klemmen.) L. KLEIN. *Glückauf*, Vol. 67, Jan. 1931, pages 81–85.

The friction of wire cables in cast iron or steel jaw clamps, coated with soft metals is shown by friction number curves. Results are given for straight strand and twisted cables, varying wire diameters, and for lead and zinc composition coatings, for pressures from 45 to 250 kg./cm.² Calibration tests show that the friction number μ_1 (friction between wire cable and soft metal) varied inversely as the acceleration, more so with zinc mixture than with lead. The friction number curves in relation to pressure showed that more uniformity was gotten with zinc than with lead. Numbers were slightly higher throughout for straight stranded cables than for twisted cables. Soft metal compositions and Brinell hardness given. DTR(6)

The Unbalanced Alternating Current Bridge for Magnetic Analysis. II. W. B. KOUWENHOVEN & J. H. LAMPE (Johns Hopkins Univ.). *Preprint* No. 34 for June 1931 meeting, *American Society for Testing Materials*, 11 pages.

Skin effect, or flux penetration, plays a part in the testing of thin knife blades. The older apparatus was unsatisfactory in classifying knife blades that had had improper heat-treatment from those that had had proper treatment. A new bridge with coils designed to give greater flux density, was constructed and was found to separate the specimens into classes corresponding to heat-treatment and Brinell hardness somewhat more satisfactorily than the older design The construction of the apparatus is discussed. Blades of standard heat-treatment, 450° F., 30 min. draw, ranging from 572 to 623 Brinell were compared with other groups. A group of the same heat-treatment and same hardness range gave a "separation" in the test of −10 to +7 units. A group drawn at 650° F., 503–519 Brinell, showed +45 to +61. One at 850° F., all 426 Brinell, +137 to +146. One at 950° F., 396–408 Brinell, +167 to +173. One with the standard heat-treatment, 592–623 Brinell, but with points softened to 341–408 Brinell, (heel and middle of normal hardness) showed −27 to −44. HWG(6)

Strength of Screw Threads. (Zur Festigkeit im Schraubengewinde.) W. KUNTZE. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 14, 1930, pages 35–38; *Zeitschrift Verein deutscher Ingenieure*, Vol. 73, April 6, 1929, pages 469–471.

The importance of a high ratio of "technical cohesion strength" (Trennfestigkeit) to tensile strength in satisfactory bolt stock, is emphasized. HWG(6)

Ballistic Measurement of Highly Permeable Materials. (Ueber ballistische Messungen an hochpermeablen Materialien.) HANS NEUMANN. *Wissenschaftliche Veröffentilchungen aus dem Siemens-Konzern*, Vol. 10, Mar. 1931, pages 55–71.

Two ballistic methods, the wire method and the ring method, are described for measuring materials of very high permeability; the errors are determined. The magnetic properties of Fe-Ni-alloys with small additions of Co are given which show that for certain amounts of Co an increase in the original and maximum permeability takes place and the coercive force is decreased. Numerous curves and 18 references are given Ha(6)

Testing Butt Welds by Magnetic Methods. T. R. WATTS. *Electric Journal*, Vol. 28, June 1931, pages 389–391.

Magnetographic inspection and weld-test meters are discussed. The weld-test meter is dependable only when all conditions are comparable to those under which the calibration curves were made. The relative merits and shortcomings of the magnetographic and weld-test methods of examination are indicated and the following conclusions drawn: (1) all types of faults commonly encountered in arc welding increase the reluctance, but not proportionately to the seriousness of the fault; (2) the magnetographic method is most sensitive to poor fusion, fissures or cracks which extend to the surface on which the iron powder picture is made; (3) the weld-test meter is equally satisfactory, in any position and is practically indifferent to the depth of the fault below the surface; (4) both magnetographic and weld-test meter methods should be employed to make up for some of the shortcomings of either; and (5) these methods are as satisfactory as any other known non-destructive weld-test practicable for shop use and equipment will doubtless soon be available. WHB(6)

Wear of Metals with Special Consideration of the Measuring Faces of Gages. (Abnutzung von Metallen unter besonderer Berücksichtigung der Messflächen von Lehren.) O. NIEBERDING. *Berichte über betriebswissenschaftliche Arbeiten*, VDI Verlag, Vol. 5, 1930, 25 pages.

A measuring method is developed and described which, particularly, makes the measuring of stresses and wear in gages possible. Tests have shown that this method works with sufficient accuracy. With increasing pressure at the rubbed place, the wear increases considerably. The weight of gages and the measuring pressure should not exceed that necessitated by accuracy. Liberal use of light metal will be advantageous. The wear increases rectilinearly with increasing path of friction, which means that gages wear in proportion to the degree of their use. The wear reached its best value for samples annealed at 400° C. A metallographic examination of this sample showed that the wear does not change greatly as long as the structures hardenite, martensite, troostite and osmondite exist; after their destruction, at about 500° C., the wearing resistance decreases rapidly. Chrome plating of gages is of extreme advantage. Of all materials, Widia (a tungsten carbide), has proved to be the most excellent material for gages because its resistance to wear by far surpasses that of all other materials. All tests and results are reproduced in curves and pictures. 24 references Ha(6)

Stress Measurements in Blooms and Bars Cooled on One Side. (Spannungsmessung an einseitig abgelöschten Knüppeln.) F. STÄBLEIN. *Krupp'sche Monatshefte*, Vol. 12, May 1931, pages 93–99.

When cooling a body in a liquid, the individual layers of the body are subject to stresses. Because of their magnitude, these stresses can no longer be assumed to be elastic and, for this reason, deform the body. The theory of determining these deformations and stresses is developed; an expression is derived which gives the relation of the stresses in the body to the deformations observed after planing off layer by layer. For 6 bars cooled on one side, the distribution of stress shows tensile stresses in the interior and compressive stresses on the exterior. Without subsequent treatment, the stresses are of the order of the elastic limit. They are reduced by annealing, even at 450° C., to about 1 to 2 kg./mm.² Ha(6)

The Hardness Testing of Electro-Deposits and Other Thin Metallic Coatings. HUGH O'NEILL. *Transactions of the Faraday Society*, Vol. 27, Feb. 1931, pages 41–51.

The factors involved in the hardness testing of thin metallic coatings have been analyzed, and the advantages and limitations of scratch test discussed. A machine designed by the author for other work, and using a 1 mm. hemispherical indenter, has been found suitable for the indentation and scratch testing of coatings down to less than 0.0005 inch in thickness, provided that they are not harder than about 400 Brinell. An empirical conversion curve for obtaining approximate Brinell numbers from scratch hardness numbers has been prepared. It is suggested that a one half mm. diamond hemispherical indenter on a machine of the same type would be of still greater utility, as harder deposits could then be tested. Scratch tests are recorded made on nickel deposited from baths of different compositions. WAT(6)

Physical Aspects of Structural Joints. Part II. J. C. OTHUS. *Welding*, Vol. 1, Oct. 1930, pages 824–829.

Tests were made on angles as tension nembers, both welded and riveted to gusset plates, to observe their behavior at eccentric loads and the distribution of stresses. The preparation of specimens and test arrangements are described and the test results tabulated and shown in diagrams. Welded members carried, in general, 23% more load than riveted ones. Ha(6)

Yield Point of Structural Steel, Report of A. S. T. M. Committee on. M. O. WITHEY, Chairman, *Preprint* No. 26, for June 1931 meeting, *American Society for Testing Materials*, 6 pages.

The rate of strain put on a tensile specimen held in wedge grips has a constant ratio to the speed of the head of the testing machine for speeds between 0.05" and 1 2" per minute. It has a greater ratio the thinner the specimen tested The yield points of mild structural steel are shown by the plots to be some 10% higher at a high rate of strain than at a very low rate. HWG(6)

Rockwell Hardness Testing of Metallic Materials, Proposed Methods of. J. R. TOWNSEND, Chairman. A. S. T. M. Sub-Committee on Indentation Hardness Testing. Append . I to *Preprint* No. 4, Report of A. S. T. M. Committee E-1 on Method. of Testing for June 1931 meeting, *American Society for Testing Materials*. 4 pages.

Detailed precautions in the use of the Rockwell hardness tester are set forth. HWG(6)

A Universal Wear Testing Machine. A. K. ZAITZEFF. (Polytechnic Institute, Leningrad, Russia.) *First Communications of the New International Association for Testing Materials*, 1930, Group D, pages 119–126.

Brief description and sketches of a machine for rubbing wear test specimens against steel, agate or emery cloth. HWG(6)

New Scientific Methods of Subdivided Wear Testing of Metals. A. K. ZAITZEFF. (Polytechnic Institute, Leningrad, Russia.) *First Communications of the New International Association for Testing Materials*. 1930, Group D, pages 86–94.

The faces of 3 cylinders of the steel to be tested, each 5 mm. diameter, are pressed against a revolving ring of austenitic manganese steel at a velocity of 1 meter/sec. and a load of 11 kg./cm.² Weight losses are determined at 10 minute periods, discarding the results of the first or wearing-in period. Wear of rails in service is said to agree well with the results of the laboratory tests. Good rails lost 2 1/2 to 3 mg., average and poor rail 7 to 11 in the laboratory test. Wear does not, from the tabulated tests, appear proportional to hardness, strength or composition. From experiments on a 0.40% C, 1.0% Mn steel at different heat-treatments, it is deduced that wear times the fifth power of the hardness equals a constant, up to the hardness obtained by quenching in boiling water. General discussion is given of the factors involved in wear. HWG(6)

Resistance of Steels to Abrasion by Sand. SAMUEL J. ROSENBERG. (U. S. Bureau of Standards.) *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1093–1125.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The author describes tests made using the ball mill, the sand blast and the Brinell machine for the determination of the resistance of steels to abrasion by sand. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 37. WLC(6)

The Effect of Occasional Overstress and Subsequent Annealing on Chain Steel and Welded Chain Steel. H. IVAN ANDREWS. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, 1930, *Applied Mechanics*, pages 113–115.

The results of the test reported in this paper indicate that occasional overload tends to increase the static and fatigue strength of unwelded chain steel at the expense of the ability to resist the energy of shocks. They also indicate that the effect of annealing after overstress is to reduce the static and fatigue strength of the unwelded metal to values as low or lower than those for the metal before overstress, and that the benefit of annealing consists in the complete or partial restoration of the shock-resisting capacity of the metal. (6)

On the Vibration of U Bars. G. H. KEULEGAN. *Bureau of Standards Journal of Research*, Vol. 6, Apr. 1931, pages 553–592.

A theoretical study has been made of elongated and short U bars with special reference to their use as vibrators in investigations on elastic hysteresis. First, an expression for the frequency of the fundamental mode of vibration of the elongated U bar is derived by solving the differential equations of motion of the yoke and of the prongs through the use of an approximation. The physical basis of the approximation is the fact that the bar vibrates with a pitch differing slightly from that of the clamped-free bar of half the length. Secondly, Ritz's method of approximation is developed for initially curved bars, the development being based on the principle of least action. In this connection a new proof is given of Rayleigh's method for determining the fundamental mode of vibration. As an illustration of Ritz's method, the example of the free-free bar is treated, and the results of the calculation are compared with the known solution of this problem. Next, the method is used to determine the fundamental mode of vibration of the short U bar, a short U bar being defined as one wherein the length of the curved portion, or the yoke, is equal to the sum of the lengths of the two parallel prongs. Finally, Rayleigh's method is used to determine the static deformation of the short U bar, produced by the application of a single load so applied that the deformation is most nearly that present in the fundamental mode of vibration. WAT(6)

Modern Testing of Hardness. HENRY PERCIVAL. *Western Machinery World*, Vol. 22, June 1931, pages 247–249.

Reviews briefly the various types of hardness testers, and describes the Monotron hardness tester. A point is pressed against the test piece until a standard fixed depth of penetration has been reached. The pressure required to secure this standard depth is the value measured directly and becomes the hardness value. WAT(6)

Commercial Tests for Cast Iron. H. W. SWIFT. *Foundry Trade Journal*, Vol. 44, Apr. 16, 1931, pages 273–276, 280.

Deals with the tensile, compression, hardness, and transverse tests and then discusses the effect of mass upon the mechanical properties of cast iron. A description of tests made on bars cast in various diameters from 1/2 inch to 3 inches is given, as well as of tests made on cast plates of different dimensions. Criticism is made of the standard test pieces specified by the British Engineering Standards Association for cast iron. Some reference is made to results of tests on separate and cast-on test bars and to the effect of removing the skin from test pieces. The paper is accompanied by 7 diagrams and 3 tables. OWE(6)

Testing Steel for Forging. ADAM M. STEEVER. *Metal Progress*, Vol. 19, June 1931, pages 45–47.

The author describes and discusses testing methods and control of the quality of forging steel stock. WLC(6)

Simple Methods for Investigating Iron Castings. (Einfache Verfahren zur Untersuchung von Eisenguss.) L. F. C. GIRARDET. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 207.

Emphasizes a new method at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. EF(6)

Damping Capacity of Materials. G. S. VON HEYDEKAMPF (Southwark Foundry & Machine Co.) *Preprint* for June 1931 meeting *American Society for Testing Materials*. 15 pages, 7 figures, 38 references.

The damping capacity, mechanical hysteresis or internal friction of metals is the work changed into heat during a cycle of reversed stress. The specific damping capacity, in which the damping is compared on the basis of the elastic modulus, is a better unit for comparing different materials. Hysteresis methods, temperature-rise methods and the torsional pendulum methods of determining damping are discussed. Damping capacity is a physical property, as inherent to a material as is tensile strength. The damping characteristics of a dozen steels, of brass, duralumin and Lautal, are shown in curves. Ability to damp tends to decrease danger of resonant vibration in crankshafts. Damping capacity should be considered in relation to fatigue properties. Damping tests are not of any value as short-time fatigue tests, but, instead give additional information. Materials having high damping values, like cast iron, are less sensitive to surface notches. They can be deformed more without damage than Hooke's "law" predicts. The damping test determines "dynamic ductility" and may be related to impact strength. Damping tests are a type of stress-strain determination, but are much more sensitive. They indicate that there is no true proportional limit. Damping limit measures plastic behavior. The plastic action that causes the damping effect may be related to "creep." HWG(6)

Methods of Testing Materials. (Materialprüfungswesen.) K. MEMMLER. Walter de Gruyter Co., Berlin, 1930. 4th Edition. Cloth, 4 1/4 × 6 inches, Vol. 1, 136 pages; Vol. 2, 110 pages. Vol. 3, 110 pages. Price 1.80 RM per volume.

These little volumes in the Göschen collection are by the Director of the government testing laboratory at Berlin-Dahlem, and while elementary, they are generally authoritative, and up to date.

Vol. 1 deals with tensile, compression, transverse, torsion and shear testing, with notched-bar impact, endurance, hardness, bend, cupping, wear and high temperature testing. There are 272 references to the literature. In regard to endurance, Memmler specifies 10 million cycles for steel, 100 million for nickel and still more for most non-ferrous alloys. He states that the so-called short-time endurance tests are not reliable. For short-time high temperature testing heating in oil or a fused salt bath is used at the Berlin-Dahlem laboratory. Comment on long-time creep testing is very sketchy.

Vol. 2 deals with non-metallic materials and vol. 3 with testing machines. The references in these bring the total to 455. Everything is very much condensed, but is useful as far as it goes.—H. W. Gillett (6)-B-

A Comparison of Various Sizes of Test Bars Representing Cast Irons from Five Foundries. Appendix I to Report of Committee A-3, A. S. T. M. In *Preprint* No. 11, for June 1931 meeting, *American Society for Testing Materials*. 8 pages.

Tensile, transverse and Brinell tests on 0.8, 1.2, 2 and 3 inch diameter bars cast from same ladle, on 5 irons ranging from (D) 3.42% C, 2.39% Si, to (E) 3.31% C, 2.14% Si (12% steel in mix). The strength of the stronger irons held up best in large sections. D had 29,000 lbs./in.² tensile on 0.8" bar, only 12,000 on 3", while E had 37,500 on 0.8", 24,500 on 3". Photomicrographs of specimens of all 5 irons, and tensile and hardness curves are given. HWG(6)

A Method for the Standardization of Permeameters at High Magnetizing Forces. R. L. SANFORD. *Bureau of Standards Journal of Research*, Vol. 6, Mar. 1931, pages 355–362.

The advent and increasing use of cobalt magnet steels requiring the application of relatively intense fields for magnetization has led to the development of a number of commercial permeameters for magnetic testing with high magnetizing forces. For the standardization of these instruments a method is required whose accuracy can be determined without reference to tests by any other method. An adaptation of the well-known isthmus method is described, which, under proper conditions, gives an accuracy well within the allowable experimental error and which can be made to accommodate specimens of various shapes and sizes. A criterion by which to determine whether or not the proper conditions for accuracy are obtained is given. Attention is called to the importance of magnetic uniformity in bars to be used with high magnetizing forces no less than in measurements as magnetic standards, which must be taken into account in measurements in the lower ranges. WAT(6)

Apparatus for Automatic Measurement of Brinell Impressions. (Appareil de mesure automatique des empreintes de l'essai Brinell.) R. GUILLERY. *Revue de Métallurgie*, Vol. 28, May 1931, pages 260–264.

A description of the constructional details of a Brinell press with an arrangement for automatic measurement of the impression. JDG(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

A Peculiar Behavior of Light Alloys in Fatigue. Correspondence from F. GIOLITTI, Turin, Italy. *Metal Progress*, Vol. 19, June 1931, pages 85–86.

The writer reports the study of elastic hysteresis in aluminum alloys and the effect of slight changes in composition on the phenomenon. WLC(6f)

The Influence of Grain Size on the Resistance to Fatigue of Mild Steel. The Effect of Cold Work, Annealing, and Overheating. (Influence de la grosseur du grain micrographique sur la résistance à la fatigue de l'acier doux. Effets de l'écrouissage, du recuit et de la surchauffe.) CAZAUD. *Comptes Rendus*, Vol. 192, June 15, 1931, pages 1558–1560.

The author determined the fatigue limit of mild steel of the following analysis: C, 0.10%; Mn, 0.45%; Si, 0.03%; S, 0.08%; P, 0.03%. This material was in the form of bars 20 mm. (0.7874 in.) diameter. The following were the mechanical properties of the bar as received:

Elastic limit	76,100	lbs. in.²
Tensile strength	80,800	lbs. in.²
Elongation, %	15.5	lbs./in.²
Mesnager number	2	

The fatigue limit of this material was found to lie between 42,000 and 42,700 lbs./in.² Samples of this steel were heated: (1) to 925° C. for two hours and cooled slowly, (2) to 925° C. for two hours and cooled rapidly in air, (3) to 1175° C. and cooled slowly. The following conclusions were reached as a result of tests made on the steel subsequent to these treatments: (1) The grain size of low carbon steel, which has a marked effect on the resistance to shock, has some influence also, though less important, on the fatigue limit. When, after a suitable annealing, a small grain size is obtained, the fatigue limit reaches its maximum value. This value is but slightly altered, provided the number of grains per square millimeter is less than 400. If, as a result of overheating, the grain size is increased, the fatigue limit can be reduced by as much as 20%. (2) Cold work, which rapidly increases the elastic limit and tensile strength, only slightly affects the fatigue limit. (3) In the case of low-carbon steel annealed under the best conditions, the ratio of the endurance limit to the tensile strength reaches the high value of 0.65, although the steel studied was not of the highest quality from the chemical point of view. (4) The fatigue limit is very close to the apparent limit of elasticity in the annealed state. OWE(6f)

The Compression of Surface. (Das Drücken der Oberfläche.) HILMAR DÖRING. *Oberflächentechnik*, Vol. 8, May 5, 1931, pages 97–99.

An abstract from the author's work, "Das Drücken der Oberfläche und der Einfluss von Querbohrungen auf die Biegungsschwindungsfestigkeit," which may be obtained from NEM-Verlag, Berlin W 10. The paper deals chiefly with compression of surface of metals and its effects upon the vibrating bending strength. The tests were conducted at Wöhler Institut and the following results were obtained: The surface of test bars subjected to compression stress above the yield point (max. reduction of cross-section from 1/2 to 1%) by means of circularly arranged rolls, would yield a higher endurance strength than those whose surface was not compressed. Thus the endurance tests conducted on various steels and non-ferrous alloys showed 15–20% increase in rotating vibration strength and from 8.5–26% in bending vibration strength. In the latter case, the compressed zone of test bar was gradually increased from the center of the bar to the ends until the breakage occurred within the compressed zone under bending stress applied by suitably arranged load to center of the test bar. In this way, the effect of varying degrees of compression was also ascertained. See also *Metals & Alloys*, Vol. 2, July 1931, page 136. ER(6f)

Construction of Fatigue Testing Machines. (Zur Konstruktion von Dauerprüfmaschinen.) W. SPAETH. *Zeitschrift für technische Physik*, Vol. 11, Apr. 1930, pages 115–118.

A system consisting of two connected oscillating masses as the principle of endurance testing machines is discussed. A brief description of an endurance testing machine for alternating torsion stress is included. 5 illustrations. EF(6f)

Stress Corrosion of Metals. D. J. MCADAM, JR. *International Association for Testing Materials, Preprint* for 1931 meeting, 19 pages.

A convenient summary of the extensive work of McAdam at the Naval Experiment Station. Corrosion-fatigue is due to the accelerating effect of stress on corrosion. Sharper and deeper pits are formed than in stressless corrosion. As pitting proceeds stress concentration at the base of the pits increases. With combined stress and corrosion, the life depends upon the cycle frequency, i. e., the time allowed for corrosion to progress. Corrosion-fatigue resistance depends primarily upon corrosion-resistance. It is not greatly affected by heat-treatment or cold-working. The corrosion-fatigue limit is a stress figure obtained under arbitrary conditions, and cannot be used directly as a basis for design. HWG(6f)

Fatigue Tests on Riveted and Welded Steel Drums and Cylinders. (Ermüdungsversuche an genieteten und geschweissten Stahltrommeln und Zylindern.) H. ILLIES. *Die Schmelzschweissung*, Vol. 10, May 1930, pages 120–121.

A test arrangement of the Babcock & Wilcox Co., which subjects steel drums periodically to varying pressures of 50% above normal operating pressure, is described. Each test comprised at least 10,000,000 changes of load. From the tests, it is concluded that welded joints can be made which reduce the fatigue strength less than does the tap for the manometer connection; it withstood 400,000 changes of load, which is about 50 times more than occur during a lifetime of a boiler; and that the strength of a welded seam depends on the kind of welding. Ha(6f)

A New Testing Machine for the Determination of Alternating Strength for Revolving Bending Stress. (Neue Prüfmaschine zur Bestimmung der Wechselfestigkeit für umlaufende Biegung.) W. SCHWINNING & E. DÖRGELOH. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, pages 186–188.

Describes a new testing machine developed for the determination of repeated stresses on wires from 1.8 to 5 mm. in diameter. Contains 7 references to previous work along similar lines. EF(6f)

On the Fatigue of Metals. Y. ASAKAWA. *Kinzoku no Kenkyu*, Japan, Apr. 1931, pages 221–236.

The author investigated the phenomenon of fatigue of metals from the magnetic and mechanical points of view; namely, he studied by magnetic and mechanical means the internal conditions of the loaded specimen in various stages of the S–N curve in the rotating beam test, or those corresponding to the various kinds of falling weight in the repeated impact test, both before and after the breaking of the specimen. The magnetic method adopted by the authors was a differential method and has such a high sensitivity that even in the case when 0.05% C steel is subjected to a very small stress, 1.2 kgs./mm.², the progress of fatigue is made evident. From the results obtained, we may conclude that the progress of fatigue is shown as the result of two magnetically opposite effects, i. e., "fineness of grain" and the "internal stress," so that the corresponding change of the magnetic or mechanical property gives an indication of the various degrees of the "cold-working" of the material. One important fact observed in the present investigation is that, even with a repeated impact by a load far smaller than "endurance limit," an increase in cold-working or the brittleness of the material can be brought about. This shows that a material which underwent a certain number of repeated impacts of a stress below its endurance limit, suffers a change of internal structure and therefore it is not the same as in its initial state. KT(6f)

The Endurance Strength of Non-Welded and Welded Cast and Rolled Materials. (Die Dauerfestigkeit ungeschweisster und geschweisster Guss- und Walzwerkstoffe.) W. B. BARTELS. *Zeitschrift Verein deutscher Ingenieure*, Vol. 74, Oct. 11, 1930, pages 1423–1426.

Test curves for cast iron, with and without skin, and for steel are reproduced. See *Metals & Alloys*, Vol. 2, May 1931, page 100. Ha(6f)

Fatigue Strength and Hardness of Nitrided Steels. O. HENGSTENBERG & R. MAILÄNDER. *Iron Age*, Vol. 127, Jan. 29, 1931, pages 400–401.

Study of the fatigue properties and hardness of a series of nitrided steels. See also *Metals & Alloys*, Vol. 2, April 1931, page 80. (6f)

Requirements and Problems Connected with High Speed Piston Engines. (Anforderungen und Probleme des Schnellaufes bei Kolbendampfmaschinen.) F. MODESOHN. *Zeitschrift für Metallkunde*, Vol. 23, Feb. 1931, pages 67–68.

Reviews the lecture delivered at the meeting "Maschinenelemente," Darmstadt, 1930, and refers to fatigue and wear resistance problems involved in high speed piston engines. EF(6f)

Fatigue of Metals. Report of Research Committee, A. S. T. M. H. F. MOORE, Chairman. *Preprint* No. 25, for June 1931 meeting, *American Society for Testing Materials*. 1 page.

Brief progress report. Comments on Lucas' micrographs at 3500× showing cracks in martensite, and on the possibility that a stress of given magnitude may be more dangerous as a cause for a spreading fatigue crack when exerted at the surface than in the interior of a piece of metal. HWG(6f)

Fatigue Tests of Model Turbo-Generator Rotors. R. E. PETERSON. *Mechanical Engineering*, Mar. 1931, pages 211–215.

Results of tests of rotor end forgings to obtain data as to safety during operation—tests with fatigue loading only, and with superimposed centrifugal stressing. 10 figs. MFB(6f)

Fatigue Tests of Weld Metal. R. E. PETERSON & C. H. JENNINGS (Westinghouse Elec. & Mfg. Co.). *Preprint* No. 39 for June 1931 meeting of *American Society for Testing Materials*. 7 pages.

Specimens of all-weld-metal, laid on between 2 blanks 1½″ diam., where the weld metal joins the blank, and built up so that the all-weld-metal section is 1″ diam. at the midsection and has a 4½″ radius, were made up by electric welding. This gives a rough specimen, to be tested unmachined, but the specimen conforms to the proper shape to avoid local stresses other than those arising from surface roughness. Such specimens were tested, machined and polished, and in the following unmachined conditions; as welded; annealed at 1000°, and at 1700° F., peened; and peened and annealed at 1000° F. Endurance limits in that order were: 10,500 to 13,000; 15,000; 16,000; 12,500; 20,500; 18,000 lbs./in.² That is, rough welds showed a better endurance limit than machined and polished specimens. This has also been found in fillet welds and was ascribed to residual stresses. To eliminate stresses, the annealing treatments were used. A 1700° F. anneal gave coarse grain structure and was harmful. The 1000° F. anneal did not have much effect. Peening was helpful, and peening the outer layer only, was as good as peening each layer as deposited. The better behavior of the rough than the machined and polished specimens may perhaps be ascribed to the opening up of pin-holes which lower the endurance. Tests on other sizes now in progress are showing higher endurance limits than those stated above for smaller specimens and lower ones for larger specimens, so this should be kept in mind when using the figures for design purposes. HWG(6f)

Requirements of Swinging Cables, with Reference to Suspension Clamps. (Beanspruchung schwingender Drahtseile unter besonderer Berücksichtigung der Beanspruchungen an den Tragklemmen von Freileitungen.) H. M. PAPE. *Veröffentichungen des Wöhler-Instituts*, 1930, No. 7, 86 pages, 17 references, 12 tables, 27 figures.

Mathematical and experimental study of fatigue failure in cables. The life of a swinging cable is decreased by an extraordinary amount with slight increase in amplitude of vibration. Use of material of high damping ability helps to reduce the amplitude. Spacing and design of clamps to hold down the amplitude and decrease the local stress at the clamp are discussed. HWG(6f)

Fatigue Tests on Small Specimens with Particular Reference to Size Effect. R. E. PETERSON (Westinghouse Electric & Mfg. Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 1041–1056.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The paper describes a small fatigue testing machine taking a specimen .050 inch in diameter at the critical section. Data from such specimens are presented and compared with that obtained on larger ones. For ordinary steels there is no appreciable size effect, but with cast irons the results were erratic and lower. Some observations on the heating effect in specimens of different diameters are given. WLC(6f)

Fatigue Properties of Crank-Shaft Steels. (Kurbelwellenbrüche und Werkstoffragen.) KURT MATTHAES. *Luftfahrtforschung*, Vol. 8, July 1930, pages 91–120.

See *Metals & Alloys*, Vol. 1, May 1930, page 524. (6f)

Fatigue Tests in Shear of Three Non-Ferrous Metals. H. F. MOORE & R. E. LEWIS (Univ. of Illinois). *Preprint* No. 42 for June, 1931 meeting, *American Society for Testing Materials*. 7 pages, 6 references, 4 figures.

Torsional fatigue tests were made on commercial Cu (49,000 lbs./in.² tensile, 15% elongation, 96 Brinell) on brass with 62% Cu, 2.8% Pb (60,000, 23%, 124) and on Duralumin (61,000, 20 ½%, 118). The tests were carried to 50 million or more cycles and calculated to 100 million. The fatigue results follow: in lbs./in.².

	Rotary Beam	Reversed Torsion	Zero to Maximum torsion
Copper	15,000	10,000	19,000
Brass	18,000	14,000	26,000
Duralumin	17,000	12,000	22,000

HWG(6f)

ELECTRO-CHEMISTRY (7)

On the Activity Coefficient of Lead Halides and on the Normal Potential of Lead. (Ueber die Aktivitätskoeffizienten der Bleihalogenide und über das Normalpotential von Blei.) H. FROMHERZ (Bayrische Akademie der Wissenschaften, München). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 153, Mar. 1931, pages 376–390.

The true activity coefficients of the lead halides were determined and the normal potential of Pb against H_2 was reexamined and found to be Pb/Pb^{++}; $E° = 0.1274$ Volts. EF(7)

Contribution to the Solution Speed of Metals in Acids. Theory of Local Elements. (Zur Kenntnis der Auflösungsgeschwindigkeit der Metalle in Säuren. Beitrag zur Theorie der Lokalelemente.) W. GUERTLER & B. BLUMENTHAL (Technische Hochschule, Berlin). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Jan. 1931, pages 197–234, bibliography.

The dissolving of Fe, Cu and Ni in 0.1 *N* HCl was studied and the conditions established which render the tests in HCl reproducible. An equipment was developed permitting the investigation of the dissolution speed of metals in acids under the view point of the local element theory at constant resistivity but under conditions otherwise changing. The assumptions of Ericson-Aurén and of Palmaer concerning the hydrogen excess voltage could not be affirmed by the authors who kept track of the dissolution of Zn in 0.2 and 0.1 *N* HCl. The changes in cathode potential according to Liebreich's statements must be taken into account. The formula governing the dissolution speed of metals in acids is given. The hydrogen excess voltage existing during the dissolution of a natural element could be calculated. The changes in hydrogen excess voltage largely influence the course of dissolution and the increase of the dissolution speed. The changes in resistivity exert a minor influence. The reactions occurring during the dissolution of Zn in HCl can be quantitatively interpreted on the basis of the local element theory even in case the dissolution speed is not proportional to the conductivity of the acid. EF(7)

Temperature Measurements on Operating Electrodes. III. (Temperaturmessungen an arbeitenden Elektroden. III.) B. BRUZS (University of Riga). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 146, Mar. 1930, pages 356–362.

The effect on Ag, Pb, Cd, Bi, Zn and Cu electrodes are measured and compared with the temperature coefficients according to Ostwald and with new calculations of entropy of ions according to Buffington and Latimer. The results are in satisfactory agreement, thus proving the usefulness of the method applied on entropy measurements of ions. EF(7)

The Problem of the Electrolytic Dissociation, Criticism of the Principles and Assumptions of the Electrostatic Theory of Electrolytic Dissociation and the Attempt of Explaining the Latter without the Assumption of Dielectric Effects. (Das Problem der elektrolytischen Dissoziation. Eine Kritik der Grundvoraussetzungen und Annahmen der elektrostatischen Theorie der elektrolytischen Dissoziation und der Versuch ihrer Erklärung ohne die Annahme dielektrischer Wirkungen.) K. FREDENHAGEN (University of Greisswald). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Feb. 1931, pages 321–379.

Thermo-dynamic derivations proving that the dissolution and ionization ability of a solvent can be dispensed with. The author's new theory assumes that the chemical affinities of the atoms are not completely satisfied when forming the molecules of a compound. On account of their chemical affinity forces, the atoms in the compounds are still able to react with other elements assuming that they are in a certain distance. Various auxiliary assumptions of the former electrostatic theory, aiming at the interpretation of the different behavior of strong and weak electrolytes, the self-dissociation of pure solvents and molten salts, the characteristic specific dissolution capacity of typical solvents as H_2O, liquid ammonia, fluoric acid, etc., are criticised and explained with the aid of the author's new theory. EF(7)

The Electro-Motive-Force Measured on Moving Electrodes and the Electro-Kinetic Potentials of Metals. (Die elektromotorische Kraft an bewegten Elektroden und das elektro-kinetische Potential der Metalle.) S. PROCOPIO. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 154, May 1931, pages 322–331.

The movement of electrodes against a metallic electrode causes an e. m. f. the magnitude and value of which coincides with the electro-kinetic potential. EF(7)

Electroplating (7a)

The Crystalline Structure of Chromium Deposits. R. J. PIERSOL. *Metal Cleaning & Finishing*, Vol. 3, May 1931, pages 369–374.

The crystalline structure of electrodeposited chromium is influenced by operating variables such as temperature and current density. The hydrogen overvoltage on nickel cathode in a chromic acid plating bath increases as the logarithm of the impressed voltage on the bath. It is predicted that the cathode efficiency of chromium would also increase as the logarithm of the impressed voltage. LCP(7a)

Deposition of Nickel at a Low pH. W. M. PHILLIPS. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1037–1038.

From paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. MS(7a)

Electrodeposition of a High Zinc, Low Cadmium Alloy on Steel, Malleable and Cast Iron Parts. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, pages 667–670.

Alloy known as "Brite-A-Loy" consists of 90 or 92% Zn and 10 or 8% Cd. It may consist of 92% Zn, 7% Cd, and 1% Cu, which results in the hardest of the alloys when deposited. The deposit is white in color and resembles Ag, but is much harder. Although corrosion resistance has not yet been fully determined by comparative tests, it is probable that the alloy will give satisfaction under any physical tests. Steel parts should be cleaned with an alkaline cleaner. Temperature of a still cleaning solution is 200° F., while that of an electrocleaner is 180° F., the voltage being 5–6. The articles are pickled in a solution of 1 part HCl, 2 parts H_2SO_4, and 7 parts H_2O, at 120° F., and then dipped in a bath of 1–2 parts HCl and 1 part H_2O at 120° F. After washing in cold H_2O, they are dipped in a bath of 4 oz. NaCN and 1 gal. H_2O. The plating bath consists of 1 gal. H_2O, 10 oz. $Zn(CN)_2$, 5 oz. NaCN, 12 oz. NaOH, and 0.20 oz. CdO. It is operated at 80–100° F. and a c. d. of 15–30 amp./ft.² of surface area at 2½–4 volts. Anode should consist of 90–92% Zn and 10–8% Cd. Ratio of anode to cathode area is 2½:1. Time of plating may range from 5 min. up. Anode rod should always be connected with the steel tank with a ⅛ in. Cu wire. High alkalinity and low free cyanide are the important factors that will give a bright luster white finish. Alloy may be used to replace Ag deposits on electric light fixtures. If an antique finish is desired, the alloy plated articles are immersed for 5–15 sec. in a solution of 1 gal. H_2O, 4 oz. $NiCl_2$, 6 oz. NH_4Cl, 2 oz. NaCNS, and 0.5 oz. $ZnCl_2$, at 90–100° F. After washing in cold H_2O, they are brushed and lacquered. All plated articles must be thoroughly washed in cold and boiling H_2O to remove all traces of the plating solution. MS(7a)

Observations on Scraped Metal Electrodes and Their Relation to the Absolute Zero Point of the Potential. (Beobachtungen an geschabten Metallelektroden und ihre Beziehung zum absoluten Nullpunkt des Potentials.) K. BENNEWITZ & J. BIGALKE. *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 154, Apr. 1931, pages 113–135.

The scraping method formerly described is improved and tests are carried out to investigate the reproducibility, influence of resistance, of additions and temperature. EF(7a)

The Recording of the Hydrogen Ion Concentration in Nickel Plating Baths (Enregistrement du pH dans les bains de nickelage.) J. BARBAUDY, A. GUERILLOT, H. MIACHON & R. SIMON. *Comptes Rendus*, Vol. 192, Mar. 23, 1931, pages 739–741.

The authors describe a method whereby they have obtained a continuous record of the pH of a commercial nickel plating bath, the method involving the use of a recording pyrometer of the Leeds and Northrup type, graduated in millivolts from 0 to 700. A quinhydrone electrode, furnished with a gold electrode, was used as a cell. The apparatus has functioned satisfactorily for 18 hours without attention, the precision of the measurements obtained being comparable with those which have been obtained with the usual pH apparatus. OWE(7a)

Study of Buffer Characteristics in Nickel Plating Baths. (Étude de l'effet tampon dans les bains de nickelage.) J. BARBAUDY & A. PETIT. *Comptes Rendus*, Vol. 192, Apr. 7, 1931, pages 834–837.

The authors describe the results of a series of experiments on 3 baths: (1) a newly made hot rapid nickel plating bath, having the composition: nickel sulphate 450 g. per liter, nickel chloride 12 g. per liter, boric acid 22 g. per liter; (2) a used hot nickel plating bath of which the composition had been modified by additions of acid, nickel carbonate, and irregularities due to service; (3) an unbuffered nickel plating bath. From values of pH corresponding to various amounts of base (or acid changed in sign) added, measured in gram equivalents per liter, the authors obtained values for the buffering characteristics of the solutions in terms of pH, the curves showing that solutions 1 and 2 are buffered on the alkaline side even when their resistance to additions of acid is increasingly lowered as the pH falls until it reaches the value of 3.5. The solution is buffered by hydrogen ions beyond this point. Solution 3 only shows the buffering characteristic at a value in the neighborhood of pH 6 due to the precipitation of nickel hydroxide. Boric acid has the effect of preventing this precipitation, even when a base of lower pH than that causing precipitation of the hydroxide is added. The foregoing experiments were carried out at a temperature of 20° C. A further series was conducted at 50° C., when it was found that the buffer characteristics were only slightly higher than those measured at 20° C. The curves, however, exhibited a remarkable widening of the buffering zone. The article is illustrated by 2 curves. OWE(7a)

Studies in the Electrodeposition of Metals. DONALD B. KEYES & SHERLOCK SWANN, JR. *Metal Industry*, London, Vol. 37, July 11, 1930, pages 35–36; July 25, 1930, pages 87–88.

Condensed from bulletin 206 of the Engineering Experiment Station, University of Illinois. See *Metals & Alloys*, Vol. 1, July 1930, page 630. VSP(7a)

Electroplating Progress. RALPH F. COHN (Reynolds Wire Co.). *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 573–576.

Purchase of chemicals in bulk, use of liquid storage, and pipe-line handling have influenced the economic aspects of the plating industry. Illustrates by discussing some of the changes which have taken place in the electrozincing of steel. Some of these improvements are due to the introduction of corrosion-resisting materials. MS(7a)

The Practical Difficulties Associated with the Electro-Deposition of Chromium. J. W. CUTHBERTSON. *Engineering*, Vol. 130, Dec. 5, 1930, page 730.

Abstract of paper read before the Electroplaters' and Depositors' Technical Society, London, Oct. 15, 1930. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 38. LFM(7a)

Anode Rods. GEORGE B. HOGABOOM. *Monthly Review, American Electroplaters' Society*, Vol 18, May 1931, pages 4–8.

Reprint, *Metal Industry*, New York, Vol. 29, June 1931, pages 247–248. The importance of keeping anode rods clean is demonstrated by the appearance of a cathodic deposit on some of the nickel anodes used in nickel plating, which were hung from an unclean spot on the anode rod. Anodes so insulated from the anode rod, either completely or partially, act as bipolar electrodes and cause losses in anode efficiency and in anode metal. Results of laboratory experiments are given and are in agreement with the bipolar electrode theory. LCP(7a)

Determining the Throwing Power of Chromium Plating Baths with the Cavity Scale. L. C. PAN. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 753–756; Oct. 1930, pages 851–854, 876.

Defines throwing power and outlines early methods for its measurement. Author has developed an instrument for this purpose called the cavity scale. It consists of a metal bar with cavities of graded depths. The cavities are numbered according to the ratio of depth to diameter. The scale is mounted on a special rack and is plated under the conditions customarily used for regular plating. The time of the test may be the same as that in actual plating, or a fixed period to be used on all tests. The highest number on the cavities which are completely covered is taken as the throwing power of the bath. Scale should be made of the same metal as the articles to be plated. Investigation carried out with brass and steel scales showed that for the best Cr bath studied, the throwing power was 45 on the brass scale and only 30 on the steel scale, the operation conditions being the same except that a c. d. of 1 amp./in.^{2} was used on the brass scale and 1.5 amp./in.^{2} on the steel scale. When both sulphate content and c. d. are high, the throwing power of the same Cr bath is much higher on steel than it is on brass. Study of the relation between sulphate content and throwing power showed that maximum throwing power on both the brass and steel scales is obtained when the sulphate content is about 1% on the basis of CrO_3. Found that trivalent Cr is more detrimental to throwing power than presence of iron in baths. MS(7a)

Studies in the Electro-Deposition of Nickel. Part II. The Effect of Current Density and Temperature. Part III. The Effect of Small Quantities of Iron and Aluminum. J. B. O'SULLIVAN. *Transactions Faraday Society*, Vol. 26, Sept. 1930, pages 533–543.

Part II. The varied surface structures of deposits obtained from buffered nickel sulphate solutions are caused by variations in the throwing powe of the solutions. The deposition potential is a logarithmic function of the current density over moderate ranges. The slope of the deposition potential-log. current density curve and the deposition potential at unit current density vary from one solution to another. It is deduced that the constants of the Freundlich adsorption isotherm are functions of the pH of the solution and of the buffering agent employed. Part III. Small quantities of iron salts have no appreciable effect on the electro-deposition of nickel. This is probably due to preferential deposition of iron, whereby the metal is removed from the cathode film before it can form any colloidal compounds. Aluminum accumulates in the cathode film until colloidal compounds form. If this process goes far enough, the structure of the nickel deposit is altered, becoming black or "burnt." These black deposits contain appreciable amounts of aluminum; white deposits contain none; hence it is likely that the co-precipitation of colloidal aluminum with nickel accounts for the phenomenon. The view that fine grained nickel deposits are due to the co-precipitation of colloidal nickel hydroxide finds support in the above observations. OWE(7a)

Nature and Cause of the Decay of Electrolytic Silver Plating. (Wesen und Ursache der Ausblühungen auf galvanischen Silberüberzügen.) H. MOSER, K. W. FRÖHLICH & E. RAUB. *Zeitschrift für angewandte Chemie*, Vol. 44, Jan. 31, 1931, pages 97–100.

This article deals with defects in silver-plating, which are shown by the authors to be due, largely, if not entirely, to the presence of non-metallic inclusions, and, in particular, to cuprous oxide in the materials being plated. The results of experiments on a copper-silver alloy and on a nickel-silver are described and the theory outlined in the above sentence based thereon. The article is illustrated by 9 photomicrographs and 1 sketch. OWE(7a)

Electroplating on Cold-Rolled Steel. G. B. HOGABOOM. *Monthly Review, American Electroplaters' Society*, Aug. 1931, pages 7–16.

Includes discussion. Difficulties with plated steel are ascribed to finishing hot-rolled steel by a small amount of cold-rolling, so that the sheet has a coarse structure in the inside and a fine-grained surface. The material may break at the junction in forming, and if heated after nickel plating, blisters appear. Similar trouble in japanning is ascribed to difference in expansion between core and surface. Hot rolling followed by a burnishing roll produces a surface oxide film. If pickled long enough to remove the oxide, a coarse surface is produced, which does not take a good plated finish. W. Fraine commented on blisters due to slag or gas pockets in steel to be plated, and C. Van Derau pointed out that the cost of polishing out defects in cold rolled steel that contains pits, rolled-in scale, and "pips" is greater than the cost of the steel itself. Insufficient cropping is suggested as a cause for gas pockets. Steel that breaks in the draw press or that develops pits in polishing is rejected. Steel makers as a whole are ignorant of the plater's needs. HWG(7a)

Industrial 'Chromium Plating. (Industrielle Verchromung.) K. ALTMANNSBERGER. *Oberflächentechnik*, Vol. 8, Apr. 21, 1931, pages 90–91.

The ratio $\frac{\text{chromic acid (mol.)}}{\text{sulphuric acid (normal)}}$ lying between 40 and 60, as set up by Engineering Research Dept. of Michigan University for optimum throwing power in commercial bright chromium plating bath, is confirmed by the author's tests. The upper limit for sulphuric acid content of bath, according to test results, shall be 1.2%. On employing higher acid content than this, or too low, the throwing power is markedly decreased; hence milky or burnt coatings are produced. Tests reveal, also, that addition of sulphate of whatever base is used, is in its action equivalent to sulphuric acid. ER(7a)

What Constitutes a Good Base for a Standard Electroplate? E. LAMOUREUX. *Monthly Review American Electroplaters' Society*, Vol. 18, May 1931, pages 13–15.

It is emphasized that good electroplating can only be obtained on a highly polished and finished surface. Before a standard for electroplating is agreed on, a standard for the quality of the surface to be plated should also be agreed on. The bearing of this question on proper machinery and equipment of polishing rooms is discussed briefly. Ha(7a)

Value of Chromium as a Finish for Plumbing Fixtures. N. G. NEAR. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, page 518.

Stresses the importance of using Ni as a base for Cr plating. A heavy plate of Cr produces minute cracks while a slash is very porous. Bureau of Standards specifies for fixtures Ni thickness of 0.002 in. and 0.00002 in. of Cr. VSP(7a)

Electroplaters' Handbook. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 987–991.

Lists the chemical, commercial and common names (with their chemical formulæ) of chemicals used in dipping, plating and coloring of metals. MS(7a)

The Maintenance and Life of Cleaning Solutions. R. W. MITCHELL. *Monthly Review, American Electroplaters' Society*, Vol. 18, June 1931, pages 30–34.

Paper before Newark Branch of American Electroplaters Society, Annual Meeting, April 1931. Metal cleaning baths lose their efficiency through (1) neutralization by acid dirt, (2) adsorption by dirt and grease, (3) drag-out, followed by dilution, (4) neutralization by CO_2 from atmosphere. Laboratory experiments show drag-out loss amounting to 1 to 2 lbs. of cleaning solution per 100 ft.^{2} of surface cleaned. Equal results were obtained by a manufacturing plant using caustic soda, 6 oz./gal. and soap, 2 oz./gal. respectively. The cost of cleaning is 10% cheaper in favor of soap. The required amount of cleaning compound in a plating shop is shown to be 0.5 to 0.7 lb./100 ft.^{2} of surface cleaned. LCP(7a)

Some Notes on Chromium Plating. MEYER ROTER. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1047–1048.

Metal concentration should not be too high for easiest possible control of a Cr solution. Specific gravity should be 30–35° Bé., with not more than 0.45 oz. of sulphate per gal. solution. Ratio of CrO_3 to sulphate is 100–1 by weight. Temperature should be about 118° F. If the bath is to be operated at lower temperature, the Cr solution may be more concentrated. Temperature should be about 5° F. lower when plating steel than when plating brass parts. Before starting to operate a solution after a lapse of time, it should be electrolized. This may be done by suspending a sheet or bar of metal on the cathode rod. Steam coils should be arranged in the bath, so that the temperature will be uniform throughout the solution. Recommends use of double Cr plate for plating uneven surfaces or parts that are poorly exposed MS(7a)

Throwing Power of Cyanide Copper Plating Baths. L. C. PAN. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 927–932; Dec. 1930, pages 1041–1044.

Describes investigation of the functions and influences of some of the ingredients and impurities in a commercial $Cu(CN)_2$ bath, with special reference to throwing power, bath voltage and character of deposit. Concludes that carbonate in $Cu(CN)_2$ baths is beneficial with regard to bath voltage throwing power and polarization. For maximum throwing power from baths containing no other ingredients than $Cu(CN)_2$ and NaCN, Na_2CO_3 should be kept between 3 and 5.5 oz./gal. $Na_2S_2O_3$ raises the throwing power, but does not depolarize the anode, nor reduce the bath voltage. Its presence is beneficial if within the limits of 0.013–0.06 oz./gal. With higher concentrations, there will be brown spots on the deposit. Addition of NaOH, preferably 0.8–2 oz./gal., improves the conductivity and throwing power, but made the deposit dull. NaCl raises throwing power and reduces bath voltage, when the concentration is between 2 and 3.3 oz./gal.; it may be used as a brightener, to overcome the disadvantages of $Na_2S_2O_3$. Recommends several formulae for Cu plating. See also *Metals & Alloys*, Vol. 2, June 1931, page 112. MS(7a)

How to Improve Durability of Chromium Plate. R. J. PIERSOL. *Chemical & Metallurgical Engineering*, Vol. 38, July 1931, pages 386–389.

For durable chrome plate, article must have contours free from sharp edges and deep recesses. Foundation metal should have fine grained non-porous structure and be free from elements which react with chromium as does zinc in brass. Nickel is an ideal intermediate plate. Automatic equipment should replace human labor and operating factors should be standardized on 15–30 minute plates which are bright, ductile, non-porous and free from excessive lateral stresses. PRK(7a)

Platers' Guidebook 1931 Edition. BY OLIVER J. SIZELOVE. *Metal Industry*, New York, 1931. Paper, 5 × 8 inches, 58 pages. Free to subscribers to The Metal Industry and Brass World.

The 1931 edition is made up of new material covering a variety of subjects in great detail, which were not included in the first edition. The scope of the new booklet can be seen from the following list of topics: Electroplating Non-Metallics, Silvering Mirrors, Cleaning, Etching, Barrel Burnishing, Polishing Before and After Plating, Plating Zinc Die Castings, Lacquering and Enameling, pH Determination.—Richard Rimbach (7a)-B-

Chromium Plating. W. H. ROWE. *Monthly Review, American Electroplaters' Society*, Vol. 18, June 1931, pages 51–56.

Paper before Hartford-Connecticut Valley Branch of American Electroplaters Society, April 27, 1931. Detailed discussion of the operation of a chromium plating plant handling a wide variety of articles. It is pointed out that barium carbonate sometimes added to the chromium plating bath to reduce excess sulphate content, often causes the bath to act erratic and difficult to restore its normal condition. Barium sulphate is not strictly insoluble in chromic acid. It redissolves gradually and upsets the chromic acid to sulphate ratio. LCP(7a)

Throwing Power of Sulfate Zinc Bath. L. C. PAN. *Monthly Review, American Electroplaters' Society*, Vol. 18, May 1931, pages 8–12.

Paper presented at the Annual Educational Session of the New York Branch, American Electro-Platers Society, Feb. 21, 1931. The cyanide and the sulphate processes of zinc plating are compared with the conclusion that the sulphate bath is superior except in the matter of throwing power. Means of increasing the throwing power of the sulphate bath are suggested such as regulating the pH value and maintaining it by a suitable buffer. For a bath containing 20 oz. zinc sulphate, dry, 6.7 oz. ammonium acetate and 2.7 oz. aluminum sulphate per gallon, the maximum throwing power is found at a pH of 4.2 (colorimetric). Bright deposit of zinc is obtained from the above bath within a pH range of 3.0 to 3.8 (colorimetric). A throwing power comparable to that of the cyanide bath is obtained by using pyridin, 0.06 oz./gal., as a buffer and a pH of 3.7. The zinc deposit from this bath is dense and bright. LCP+Ha(7a)

Barrel Plating with Zinc-Cadmium Alloys. LAWRENCE E. STOUT & I. KOWARSKY. *Metal Industry*, N. Y., Vol. 29, July 1931, pages 297–299.

Paper read before the American Electroplaters' Society at Rochester, N. Y. June 29–July 2, 1931. Bright Zn-Cd alloys, good for the prevention of corrosion of steel, were barrel plated from solutions containing sodium cyanide 9.7 oz./gal., sodium hydroxide 1.1 oz./gal. with either cadmium oxide 3.7 oz./gal. and zinc cyanide 0.8 oz./gal. or cadmium oxide 5.1 oz./gal. and zinc cyanide 0.1 oz./gal. Current density was 25–40 amps./sq. ft. at 72° C. The solutions had excellent throwing power and no addition agents were needed. PRK(7a)

Silver Cadmium Alloys for Metal Finishing. LAWRENCE E. STOUT. *Metal Cleaning & Finishing*, Vol. 3, June 1931, pages 457–459.

A cadmium-silver alloy plate containing 24% silver is produced from a bath made of

	oz./gal.
Cadmium oxide	6
Silver cyanide	0.4
Sodium cyanide	16.5
Sodium sulphate, anhyd.	6
Nickel sulphate	0.02
Turkey red oil	1.5

using cadmium anodes. The ratio of anode surface to cathode surface is maintained at 2 to 1. At a current density of 9–10 amp./ft.^{2} and room temperature, the deposit is white like silver, resists the action of sodium polysulphide and hydrogen sulphide, is ductile, uniform in thickness and easily adherent to copper, steel and other metal surfaces. LCP(7a)

Effect of Various Metallic Sulfates upon the Throwing Power of a Chromium Plating Bath. LAWRENCE E. STOUT & JONAS CAROL. *Industrial & Engineering Chemistry*, Vol. 22, Dec. 1930, pages 1324–1325.

The addition of Ni, Co, Zn, Cd sulphates to a chromic acid plating bath in the ratios of CrO_3-SO_4 of 200:1 or 150:1 increases the throwing power of the bath. Cd sulphate used in these proportions gives the highest throwpower. Ni and Co sulphates give a deposit which is much more resistant to the solvent action of HCl. Metals, as sulphates, in these proportions do not deposit at the cathode with the chromium. MEH(7a)

Plating with Rare Metals. JOSEPH ROSSMAN. *Metal Industry*, N. Y., Vol. 29, June 1931, pages 245–246.

There is given a description of recent and expired patents covering plating with platinum, palladium, rhodium and iridium. PRK(7a)

The Electrolytic Deposits on Aluminum and Its Alloys. (Die elektrolytischen Niederschläge auf Aluminium und seinen Legierungen.) M. BALLAY. *Oberflächentechnik*, Vol. 8, Jan. 20, 1931, pages 12–13.

Taken from *Comptes Rendus*, Part 190, 1930, page 305. A new process for commercial nickel plating of aluminum or its alloys is described by the author. This process gives a tightly adhering and corrosion-resistant coating. According to invention, the surface of aluminum is etched with iron chloride solution acidified with HCl preparatory to plating. The proper concentration of iron chloride and HCl is dependent upon the alloy used, but must be within the limit 6–22 g. iron and 0.10–0.70 mol. HCl/liter. The procedure of coating is as follows: (1) Removal of fats; any known bath, as for example electrolytic bath containing 10% sodium carbonate, may be used. Care must be exercised that aluminum itself is not attacked. Electrochemical treatment of surface; rinsed objects are immersed for 10–30 sec. in boiling solution of about the following composition: water 100 liters, saturated iron chloride solution (45° Bé), or solid iron chloride of proper ratio—3 liters and HCl, 1 liter. (3) Nickel bath; carefully rinsed with water, material is plated according to known method. If a subsequent chromium plating is necessary, the nickel bath must have a higher temperature and a higher current density must be employed. ER(7a)

The Practical Chromium-Plater. (Der praktische Verchromer.) *Oberflächentechnik*, Vol. 8, July 21, 1931, pages 151–153.

A general description and discussion of present chromium-plating methods; 2 are in use in Germany. One is the Langbein-Pfannhauser bath with exhauster equipment and the other is the Blasberg bath with a protective layer on it. The chromium deposit is now usually applied over a Ni deposit because the latter gives a more effective rust protection, but chromium-plating gives a harder and better surface protection of the Ni. The composition of baths, operation, preparation of the pieces, reason for failures, etc., are discussed in general. Ha(7a)

Anode Rods. GEORGE B. HOGABOOM. *Monthly Review, American Electroplaters' Society*, Vol. 18, May 1931, pages 4–8; *Metal Industry*, N. Y., Vol. 29, June 1931, pages 247–248.

Anode rods should be kept clean, otherwise the anode becomes partially insulated. This affects plating voltage as well as anodic corrosion. Ha+PRK(7a)

Electrometallurgy (7b)

New Developments in Applied Electro-Chemistry with Reference to Large Plants for Aqueous and Molten Liquid Electrolysis. (Die neuere Entwicklung der technischen Elektrochemie unter Bezugnahme auf grosse Anlagen für wässerige und schmelzflüssige Elektrolyse.) GEORG EGER. *Elektrotechnische Zeitschrift*, Vol. 51, May 29, 1930, pages 771–776, 809–815.

The present status of applied chemistry and the possible trend of future developments is exhaustively described and discussed. The article deals with the quantities of production, increase of current density both in the electrolytic baths and electrodes. Two principal methods are distinguished thus: processes with soluble anodes (refining processes) and methods with insoluble anodes. A great many diagrams show connection and wiring of the baths, the physical arrangement in the sequence of the process through the shop and during the different stages. The processes of aqueous solutions are mostly used in the electrolytic production of metals, particularly of Cu and Zn; details of the Anaconda and Taiton processes are given. Further, the electrolytic production of rare metals, Sn, Sb, Cr, Ni, Co, Mn, Cd, Pb, Fe are discussed. Information is given on modern factory methods and chromium-plating and cadmium-plating. Methods for commercial production by electrolysis of chlorine, water, electrolytic oxidation and reduction are described. The molten liquid processes are mostly used for production of light metals, Al, Mg, Be. In conclusion, electrical questions are discussed with regard to the most economical current generation and price. Photographs of factory installations and a list of references supplement the very instructive paper. Ha(7b)

Recent Advances in Technical Electrolysis. (Die neueren Fortschritte der Technischen Elektrolyse.) J. BILLITER. Verlag von Wilhelm Knapp, Halle (Saale) 1930. Paper, 7 × 9½ inches, 328 pages. Price 22 RM.

While much of this book refers to production of oxygen, hydrogen, chlorine, etc., the bulk of it deals with electro-winning or electro-refining of metals. The refining of Cu, Ag, Pb, Ni, Sn, Zn, Cd, Co, Bi, Sb, is discussed and some comment is given on production of Fe tubing and sheet by electrolysis. The description of processes for Cu and Zn are the most complete.

Under electrolysis of metals from fused salts, Na, Be, Al, including the Hoopes process, Mg, Ca, Ce, etc., Ba, Sr and Li are all discussed.

An effort has been made to deal with the commercial practice in all countries rather than to confine the description to German plants only. Some of the information is naturally hardly up-to-date, but it is rather more so than in many books of this class. A dozen flow-sheets showing the order of operations in large Cu and Zn plants are appended.— H. W. Gillett (7b)-B-

Electrochemistry and Electrometallurgy. Annual Report of Committee on Electrochemistry & Electrometallurgy. P. H. BRACE, *et al.* *Electrical Engineering*, Vol. 50, July 1931, pages 570–574.

A report for the years 1929 and 1930. The more important developments in electrochemical and electrometallurgical arts in this period, particularly as regards Cu and Zn refining, Na, Al, Ba, Be and Mg production, etc. Other subjects discussed include: carborundum, cleaning of metals, primary and secondary batteries, electric melting furnaces, water purification, sterilization of milk, electrostatic precipitation, metal powders, and some miscellaneous processes and plants. WHB(7b)

Examples of Hydrometallurgical and Electrometallurgical Operations. II. Gold and Silver. THOMAS P. CAMPBELL. *Colorado School of Mines Magazine*, Vol. 21, July 1931, pages 9–13.

The second of a series of articles on "Principles of the Metallurgy and Electrodeposition of the Metals." It deals with various phases of percolation, the arrangement of plant, slime or agitation leach, precipitation, refining, regeneration of cyanide. Percolation is divided into two classes, dry and wet treatment. The former is applied to materials coming from tailing ponds and dry-crushing mills, and the latter is applied to ores delivered wet as a flowing pulp from mills or previous treatment. A flowsheet is shown for a 500-ton combination flotation and cyanide plant. Direct operating costs and metallurgical results of Northern Ontario mills are tabulated. WHB(7b)

Electro-Thermic Aluminum. (L'Alluminio Elettrotermico.) A. PAOLINI. *La Metallurgia Italiana*, Vol. 23, July 1931, pages 603–623.

The history of electrolytic aluminum is briefly traced, that of electrothermic aluminum more fully. Electro-thermic ferro-aluminum has been produced on both the experimental and the commercial scale, containing 30–50% Al, 3–13% Si, 3% Ti, 2.5 to 3.8% C and varying amounts of Ca up to 0.4%. It is calculated that Al in ferro-aluminum can be produced at 1.1 lire/kg. contained Al against 1.9 lire for electrolytic Al. By using bauxite not too high in Fe, sand and anthracite, a silico-aluminum can be produced of 50–56% Al, 33–36% Si, 2.5–11% Fe, 2–2.5% Ti, 0.5–1.0% C and 0.5–0.9% Ca by suitable remelting and liquation, though the first product has 3 to 4% C. By using pure Al_2O_3, kaolin and petroleum coke, such alloys as 66.4% Al, 32% Si, 0.7% Fe, 0.3% C, 0.1% Ti, 0.3% Ca, 0.05% P and traces of S, can be made which may serve as a base for Alpax or Silumin though it is admitted that Ti and Ca may be inconvenient impurities and the removal of all carbides is apparently very difficult. Such an alloy should be a cheaper source of Al and Si for the Alpax type of alloys than the commercially pure metals. Calculations are stated to show that production of 99.5% Al through electro-thermic Al-Cu-Si alloys, purified by the Hoopes process should not cost more than 2 lire/kg. HWG(7b)

Some Experimental Results Obtained from the Preparation of Electrolytic Sheet Iron. C. KADOTA. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 127–131.

In English. A few experiments on making iron sheet by deposition from a chloride or chloride sulphate bath are described. The temperature used was 80° to 90° C. and current densities varied from 3½ to 6 amperes/dm.^{2} Gray or white pig iron or steel sheet was used as anode. Current efficiency is stated to be 95%. The analysis of the product is not given, but it is stated that 0.01% Cl and small amounts of Cu, P and S were found in the deposits. Sheet of 0.1 mm. is considered the most economical thickness to produce. The sheets were not free from pin-holes. HWG(7b)

Electrolysis of Molten Salts and Secondary Reactions. (L'electrolyse ignee et les reactions secondaires.) L. ANDRIEUX. *Journal du Four Electrique*, Vol. 40, Feb. 1931, pages 60–61; Mar. 1931, pages 98–100; Apr. 1931, pages 139–140; May 1931, pages 177–180.

Part 1 gives a short sketch of the development of the electrolysis of molten baths. Part 2 outlines the mechanism of electrolysis. Part 3 gives a brief description of the Heroult process for making Al and Hoopes' method for the production of pure Al and the American Magnesium Co. method for the preparation of Mg. Some general consideration regarding the electrolysis of oxides are given, particularly with the use of molten boric anhydride and a mixture of it with other salts, especially fluorides. (Recherches sur l'electrolyse des oxydes metalliques dissous dans l'anhydride borique ou dans les borates fondus. L. Andrieux. *Annales de Chimie*, Vol. 12, Nov.-Dec. 1929, pages 424–507.) Part 4. When molten borax kept at the temperature of 900° is electrolyzed using a cathode kept at about 750–800° on cooling it can be seen that next to cathode a layer of pure Na is formed, then a heavier layer of Na mixed with B, a thin layer of B and then a mass of solidified electrolyte. With higher operating temperatures the proportion of Na diminishes and at 900° only B is produced. Decomposition of Na oxide in the first stage of the reaction reduces part of the B oxide forming with the rest a metaborate. Using B_2O_3 as a solvent for oxides of reducing metals it was found that Na, K, Al and Mg reduce B_2O_3 with the formation of more or less pure B. Li, Ca, Sr, Ba, Ce and Mn produce a mixture of B with borides in which the latter predominate. With Na and K the reduction is incomplete, much oxygen is still left, but with Al and Mg pure B is produced. The best results are obtained by electrolyzing a bath containing B_2O_3, MgO and MgF_2 kept at 1100°. 21 different borides were prepared by adding to the former baths oxides of appropriate elements. A number of oxides electrolyzed in a mixture of borates and fluorides are transformed into their elements. Zinc produced in this way can be used for reduction of WO_3 and MoO_3 added to the above baths with production of pure W and Mo. JDG(7b)

Preparation of Metal Powders by Electrolysis of Fused Salts. II. Thorium. F. H. DRIGGS & W. C. LILLENDAHL. *Industrial & Engineering Chemistry*, Vol. 22, Dec. 1930, pages 1302–1303.

Four references. The purified powder obtained by electrolysis as described in this article, has been utilized for making X-ray targets, sheet and wire by pressing, sintering and degasifying the powder in vacuo. Electrolytic thorium is extremely soft, well annealed samples having a hardness as low as D-10 on the Rockwell scale. Bars of this metal may be cold-worked to almost any extent without intermediate annealing. MEH(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Characteristics of Sprayed Aluminum Coatings. (Merkmale gespritzter Aluminium-Haufwerke.) H. REININGER. *Aluminium, Hauszeitschrift der V. A. W. Erftwerk*, Vol. 3, Jan.-Mar. 1931, pages 66–75.

Metallization of metallic as well as non-metallic materials by spraying with aluminum is eminently suitable for coatings of any thickness. To assure good adhesion, the surface of smooth materials must first be roughened either in pickling liquid or by sand-blast. The sprayed coatings can be refined and improved by thermal or mechanical treatment; the texture thus produced is of higher quality than the original textures. This refers particularly to an effective protection against corrosion and erosion; but great stresses, static as well as dynamic, are not admissible. A great number of illustrations and 9 references supplement the paper. Ha(8)

Hot Tinning Steel, Wrought, Cast and Malleable Iron Parts. CHARLES H. PROCTOR. *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 593–594.

Pure Straits Sn is preferable. When the melting point is reached in the kettle, the Sn should be covered to a depth of 1 or 2 in. with either tallow or palm oil. Flux consists of a saturated solution of $ZnCl_2$ and NH_4Cl. Steel parts are cleaned, pickled, coated with flux, and immersed in the molten Sn for 1–2 min. After removal from the Sn, they are shaken, quenched in hot H_2O or kerosene and dried. Sand-blasting is the ideal method for cleaning cast-iron. If flux does not work with cast or malleable iron, articles made of these metals should be immersed in concentrated HCl for a few moments after sand-blasting, dried by heating and immersed directly in the molten Sn. If sand-blasting apparatus is unavailable, a 15–25% HF solution at 110° F. should be used for pickling. The parts are then washed thoroughly in cold H_2O, dipped in a solution of $^1/_2$–1 part NaOH and 4 parts H_2O, washed thoroughly in cold and boiling H_2O and tinned. MS(8)

Lead Coatings on Metals Which Are to Be Cold Worked. (Ueber die Verbleiung von kalt zu verformenden Metallen.) G. DE DUDZEELE. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 205.

Lecture delivered at the International Congress for Mining, Metallurgy and Applied Geology, Liege, June 1930. EF(8)

Improving the Appearance of Galvanized Sheets. HEINZ BABLIK. *Metal Industry*, London, Vol. 38, May 1, 1931, page 448.

There has been introduced within the last 6 months the process of coating hot-galvanized sheet with a thin layer of copper. The copper layer is thick enough to resist atmospheric attack for a long time and so protect the zinc coating. PRK(8)

Nickel-Clad Steel Plate Work. W. G. HUMPTON, F. P. HUSTON & R. J. MCKAY. *American Metal Market*, Vol. 38, Apr. 9, 1931, pages 9, 10; Apr. 10, 1931, page 10; *Mining & Metallurgy*, Vol. 12, Feb. 1931, pages 90–93.

Presented at Institute of Metals Division Annual Meeting, Feb. 1931. New product is heavy plate, $^1/_4$ to $^3/_8$ in. thick, one side coated with Ni, weight of Ni roughly 10% of entire weight, with hot-rolled steel plate finish. In making this plate relatively thick layers of steel and Ni are placed in intimate contact, heated to high temperature and rolled to finished plate. Bonding of 2 metals depends upon tendency of Ni to alloy with steel at high temperatures to form solid solutions at plane of contact. Important points are: (1) corrosion-resistant surface must be continuous; (2) all joints must be strong and prevent galvanic, or concentration cell corrosion; (3) all sheared edges must be covered; (4) rivets and other joints must be designed to prevent seepage of corrosives to the steel, even through the smallest crevices. In heating this plate for hot work it is absolutely necessary to provide fuel with low S content, not over $^1/_2$%, or else intercrystalline attack occurs, resulting in damage to Ni. DTR(8)

Spray Zincing. (Spritzverzinkung.) D. MATZINGER. *Elektrotechnische Zeitschrift*, Vol. 51, Jan. 30, 1930, page 184.

Short description of a zinc-coating plant in Holland where, in the last three years, more than 3000 tons of iron structure of all kinds have been successfully and economically treated by spraying. HA+WHB(8)

Tin-Plate Decoration and the Lacquering of Food Containers. A. L. MATTHISON. Published by the author, Birmingham, England, 1931. Cloth, $8^3/_4 \times 5^1/_2$, 135 pages. Price 12s. 6d.

This book is written in a somewhat colloquial style, and pays a good deal of attention to the products of the firm with which the author is connected, describing them by trade names only. As a maker of lacquer, the author continually points out the protective value of lacquer against corrosion by acid food products, though he does admit the danger of perforation at a crack in the lacquer. He stresses the importance of using prime tin plate, free from pin holes in the coating, and of proper cleaning before lacquering.

There are some general comments on drying ovens and many incidental observations on English and American practice in lacquering and some little information on decorative color printing. The suggested answer to many difficulties mentioned is to use some particular product of the author's firm. The preface states that the book is intended to be a useful work of reference. The reviewer would class it as an advertisement pure and simple.—

H. W. Gillett(8)-B-

Tinning the Inside of Copper Pipe. (Innenverzinnung von Kupferrohren.) HERBERT KURREIN. *Metallwirtschaft*, Vol. 10, July 24, 1931, page 600; July 31, 1931, page 616.

The two possible methods of tinning are thermal and by electroplating. There are several objections to the thermal method, which can be done only by dipping in the case of pipe. The outside of the pipe must be treated with clay or graphite to prevent it from being tinned. Excess Sn must be removed from the inside. Due to the uneven surface and different coefficient of expansion of the two metals, cracks and porous spots may appear. Inclusions of Cu_2O will start corrosion. In earlier attempts to plate Sn on Cu long needles were formed which did not adhere firmly. Schlotter developed a plating solution containing phenolsulphonic acid and bivalent Sn which can be used at 20° C. and forms a continuous, well adhering, non-crystalline deposit. It is used with 1–2 amps. dm.^{2}, but can be used up to 10 amps. The Sn anodes go into solution at the same rate as Sn is deposited from the solution and the throwing power is good. In plating pipe, inside anodes must be used, held in place by wooden or hard rubber insulators. Current is chosen according to the diameter of the pipe and agitation of the bath is necessary. Pipe can be plated inside only or inside and outside. The process is easy to control and is cheaper than the thermal process. CEM(8)

Zinc Coating of Iron and Steel. Report of Sectional Committee, A. S. T. M. J. A. CAPP, Chairman. *Preprint* No. 28 for June 1931 meeting *American Society for Testing Materials*, 3 pages.

The Committee has requested the A. S. T. M. to withdraw from its publications the proposed specification for zinc-coating on iron and steel sheets published, as information, in 1929. Brief progress reports are given on the work of sub-committees. These committees are mostly joint ones, and their reports are abstracted under other headings. HWG(8)

INDUSTRIAL USES & APPLICATIONS (9)

International Coöperation in Aircraft Materials. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 19, Mar. 1931, pages 85–86.

The writer reports on studies of the International Congress in Paris toward the production of safer aircraft. WLC(9)

Electron Metal in Aeronautics and the Europa Rundflug. (Ueber Elekronmetall im Flugzeugbau und Europarundflug 1930.) J. RUHRMANN. *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, pages 317–318.

The importance of the new methods for welding Mg is stressed. Due to satisfying properties of the welding joints and of the corrosion resistance, brass tanks formerly used could be replaced by electron metal tanks. The developments of plastic deformation methods, is considered, resulting in an increased utilization of electron sheets, profiles, tubes, etc., and the quality of electron castings is dealt with. The results of the Europa Rundflug with respect to the application of electron are discussed in conclusion. EF(9)

Use of Aluminum in the Electrical Industry. (L'impiego dell 'Aluminio nell' Industria Elettrica.) C. PRAMAGGIORE. *Metalli Leggeri*, Vol. 1, Mar. 1931, pages 109–128.

Discussion of virtues of Al conductors as against Cu, of insulation by oxide films, description of switches, transformers, electrolytic condensers, rotors, light reflectors, etc. HWG(9)

On Rope Wire. J. M. ROBERTSON. *Royal Technical College Metallurgical Club Journal*, Glasgow, No. 7. 1929–1930, pages 20–31, 14 figures, 9 references.

Internal wear and corrosion are more serious than external wear in producing failure of wire rope. Failure, in which the wires of the strand break one by one, is not a simple problem in fatigue failure. The most important property of wire for rope is the shape of the stress-strain curve. Cold drawing of patented wire without any heating for stress release gives a curve with no elastic range, the apparent proportional limit being extremely low, so that elastic and plastic deformation can take place simultaneously when the wire is spun into rope. The wire then bends evenly into place. Material with a steep stress-strain curve or with a definite yield point does not work so well, the first taking too high stress to deform it, the second yielding in steps. A solid diagram is shown for effect of time and temperature on tensile strength of wire. HWG(9)

Reduction of the Weight of Columns for Steel Building Structures. (Verringerung des Konstruktionsgewichtes von Säulen für Stahlskelettbauten.) B. BAUER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 30, 1931, pages 687–688.

If the carrying capacity of the concrete is taken into consideration, great savings in weight and cost of steel skeletons of buildings can be effected. Too frequently this phase is neglected. The result is an excess of steel, sometimes as great as 80%. A method of eliminating this waste is advanced. Ha(9)

Aluminum and Its Alloys in the Construction of Mobile Material for Railways, Street Cars and Busses. (L'Alluminio e la sue leghe nella costruzione del materiale mobile per Ferroyie, per Tramvie e delgi Autobus.) M. HUG. *Metalli Leggeri*, Vol. 1, Apr. 1931, pages 167–174.

General comment on improvement in ratio of useful weight to dead weight through use of light alloys. HWG(9)

Progress in Aircraft Material Development. J. B. JOHNSON (Army Air Corps, U. S. A.). *Aviation*, Vol. 30, Jan. 1931, pages 40–42.

Excellent summary of uses of various metals and alloys for different aeroplane parts. Steel and light alloys for wings. Welded truss-type fuselages. Heat treatment made after all welding in every case. Material has tensile strength of 150,000 lbs./in.^{2} For built-up sections extruded and rolled shapes of Al alloys are best, with special heat treatment, followed by cold working. Riveting followed by heat treatment is only satisfactory method for joining duralumin type alloy. For wing covering corrugated and flat Al alloy sheet. Heat treated Al alloy castings of tensile strength of 30,000 lbs./in.^{2} and 6% elongation give long life, average 5 years. Most satisfactory corrosion resistant steels contain 18% Cr and 8% Ni. For fuel, water and oil lines Cu is used. High price of Mg alloy castings has retarded their development. DTR(9)

Light and Ultra-Light Alloys and Their Use in the Automobile Industry. (I Metalli leggeri ed ultraleggeri e la loro applicazione nell' automobilismo.) G. GUIDI. *Metalli Leggeri*, Vol. 1, Apr. 1931, pages 163–166.

A paper presented in Jan. 1922 to the Academy of Science in Turin, but stated by the editor of the journal to contain much of present interest in regard to the Mg base alloy, "Lepto," used for pistons. The composition of this is not given, save that it contains Al and Zn. Greater power at high speeds is claimed for Mg pistons. HWG(9)

Thin Plates in Peace and War. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 18, Dec. 1930, page 86.

The writer reports experience with sheet and plate for protective purposes and gives the essential properties of useful armor. WLC(9)

Stainless Steels Used in Heavy Machinery. CHARLES E. HERD (Montreal Engineering and Machine Works). *Metal Progress*, Vol. 19, Jan. 1931, pages 44–49.

The author describes the application of stainless steel to paper mill machinery and hydraulic turbines. WLC(9)

Traveling Cranes Built of Aluminum Alloy. E. G. HARTMANN. *Power*, Vol. 73, Mar. 31, 1931, pages 518–519.

See *Metals & Alloys*, Vol. 1, July 1930, page 630. (9)

Tool Steels in the Ceramic Industries. H. L. HARRISON. *Ceramic Age*, Vol. 16, Dec. 1930, page 321.

Points out the advantages of high grade alloyed steels for use in dies or liners in the manufacture of bricks and tile and describes a few suitable steels. Ha(9)

Aluminum Alloys with Special Reference to Alclad. (Aluminiumlegierungen, insbesondere Alklad.) P. M. HAENNI. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 205.

Brief reference to a paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. See "Results Obtained with Aluminum in Construction of Street Cars and Railway Coaches," *Metals & Alloys*, Vol. 2, July 1931, page 131. EF(9)

Metals for Coins. GUICHARD, CLAUSSMANN & BILLON. *Iron Age*, Vol. 126, July 24, 1930, page 216.

Presented to the Académie des Sciences, Paris. This is a brief abstract translation, being an investigation of the limit of hardness obtainable with certain metals for making coins and medals by stamping. With a reduction of about 76% Ni, and a Cu alloy with 8.8% Al showed greatest degree of hardness. These were followed by bronze of 94% Cu, 4.6% Sn and 1.4% Zn and by Au 90% pure. VSP(9)

Art-Craft Welding. (Kunstgewerbliche Schweissarbeit.) FUECHSEL. *Autogene Metallbearbeitung*, Vol. 24, June 1, 1931, pages 164–167.

Description of various methods of obtaining artistic effects in metal working. Photographs illustrate the many possibilities in ornamentation. Ha(9)

Light Alloys at the Twelfth Aeronautical Exposition. (Les alliages légers au XIIe salon de l'aéronautique.) DOUCHEMENT. *Revue de Métallurgie*, Vol. 28, Apr. 1931, pages 185–193.

Practical advantages of the application of light alloys to airplane and automobile constructions are pointed out. Usually duralumin type heat treated alloys are used. Their usual characteristics: elastic limit 24–28 kg./mm.², tensile strength 40–45 kg./mm.² and elongation 16 to 20%. Often the metal is protected by a layer of pure aluminum rolled on it, as in Vedal process. Protection produced by it is satisfactory because electrolytic action prevents any attack of the base as long as any Al still remains. JDG(9)

Selection and Heat Treatment of Gear Steel. E. F. DAVIS. *Fuels & Furnaces*, Vol. 8, Oct. 1930, pages 1341–1348, 1385.

Gear steel must contain a minimum amount of inclusions. If these are of microscopic size and will disseminate, they lessen the number of gears per grind, dull the cutter rapidly and produce minor ridges and roughness on the gear tooth. In large segregates, they cut a groove in the cutter. Grain size must be uniform, a fine grained steel being preferable because of the higher impact and fatigue values. Content of C is usually within the 0.5% range. Steels used are of 2 classifications—oil-hardening grade and carburizing grade. Gives the chemical composition and describes the physical characteristics of the individual automotive gear steels which make them suitable for a particular kind of service. Outlines heat treatment necessary to produce the best results. Most popular oil-hardening steel is SAE 5150 with 0.48–0.52% C and 0.88–1.10% Cr. The best oil-hardening steels are SAE 2345 and SAE 2350, containing 3½% Ni and 0.40–0.55% C. They are highest in impact value, although not higher in physical values nor fatigue properties. Most extensively used gear steel is 3½% Ni steel. This carburizes at 1650° F. Best of all gear steels is 5% Ni steel. It is the highest in impact value, strength and fatigue properties. MS(9)

A New Cap for Steel Flasks. (Eine neue Stahlflaschenkappe.) W. GELDBACH. *Die Schmelzschweissung*, Vol. 9, Apr. 1930, pages 83–84.

This new cap is made so that it will unscrew easily and so it is not necessary to damage the flask to get it off. It also serves as a wrench for the valve. Ha(9)

Welding Technique in the Building Trade. (Schweisstechnik im Baugewerbe.) H. JUERGENS. *Die Schmelzschweissung*, Vol. 9, Sept. 1930, pages 207–209.

A few samples of doors, gratings and similar parts as used in the building of dwellings. Ha(9)

Steel Castings as Machine Parts. R. A. BULL. *Machine Design*, Vol. 3, Apr. 1931, pages 36–39.

The difficulties of casting pieces in steel due to the high shrinkage are discussed in the case of the structural texture shown in micrographs. A principal requirement for a good casting is that it should have as much similarity in respect to the thickness of every member as the conditions of use permit. Great care and, often, considerable expense must be used in mold construction to secure uniform cooling of the casting. Ha(9)

Aluminum in the Decorative Arts. (L'Alluminio nell 'Arte Decorative.) S. BRUNELLI. *Metalli Leggeri*, Vol. 1, Mar. 1931, pages 97–108.

Profusely illustrated description of modern architectural and decorative use of Al. HWG(9)

Development of the Drop-Forged Metal Propeller. FRANK W. CALDWELL. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 2, *Aeronautical Engineering*, pages 73–76.

The author tells of various types of metal propellers for airplanes, and their advantages and disadvantages. These include a tubular type, a type built up of various structural members riveted or welded together, the plate type and the drop-forged type which is the latest development. Hollow blades of aluminum alloy suitable for drop forging are used. The weight of these is slightly more than similar wooden propellers and the limit of life has not yet been established. (9)

Aluminum and its alloys. (L'Alluminio e le sue leghe.) F. LIBERA. *Metalli Leggeri*, Vol. 1, Jan.-Feb., 1931, pages 19–28.

Very general, rather non-technical article, illustrated by photographs of some applications to transportation architecture, etc. Several photos are shown of mosaics of porcelain and aluminum. HWG(9)

Application of Light Alloys in Naval Construction. (Note sulla possibilità di applicazione delle leghe leggere nelle construzioni navali.) C. PANSERI. *Metalli Leggeri*, Vol. 1, Mar. 1931, pages 83–95; Apr. 1931, pages 143–161. 104 references.

General discussion of desirability of weight-saving in naval construction and importance of avoidance of corrosion in light alloys for this purpose. The work of Baumeister on the "KS sea water" type alloy is quoted. According to Sterner-Ranier, this alloy has a "theoretical" composition of 2½% Mg, 2½% Mn, 0.2% Sb, balance Al. The treatment of Al alloys with Cl_2, N_2, BCl_3 or $TiCl_4$ to produce greater soundness and smaller grain size is discussed, with the idea that these may lead to better corrosion resistance. Alclad, paint, varnish and bitumastic protective coatings, anodic oxidation, the Jirotka process for putting on a surface film, aluminum paint coatings, etc., are discussed. The structural properties and strength-weight ratios of many alloys are given to show the value of the light alloys. The fatigue properties are tabulated. Corrosion-fatigue is briefly discussed. Applications of Al alloys to naval purposes are discussed and illustrated. HWG(9)

Magnesium and Hollow-Steel Propellers. G. T. LAMPTON (Hamilton Standard Propeller Corp.). *Preprint* for May 1931 meeting, Aeronautic Division, *American Society of Mechanical Engineers*. 7 pages.

The endurance limits of propeller alloys are: heat-treated duralumin 12,000 lbs./in.²; magnesium alloy 10,000; Cr Mo steel of 200,000 tensile 90,000. On the endurance-density basis, the 3 are in the approximate ratio 1:1¼:2⅔. The problem is to fabricate the last 2 so as to hold down weight, and get the benefit of the higher endurance ratio. The Mg alloy with 4% Al, ½% Mn is now being forged satisfactorily, and makes a lighter propeller than dural, and shows up better on whirl tests. A new method of making hollow steel propellers starts with cold-drawn seamless tubing which is tapered and thickened over the tip half by swaging, then annealed and elongated on a mandrel. The tube is then turned to the proper thickness in wall taper, the tip heated and closed by spinning. The closed end tube now has the proper circumference and wall thickness at each point, but is of circular cross section. Squeezing the tube into blade shape is then done by heating to 1650° F. and pressing it between high test cast iron dies while 300 lbs. air pressure is forced into the tube. The formed blade is then reheated, and again placed in the dies, now touching the dies at all points at once, instead of progressively as in the forming. Air pressure is again applied. Thus, the blade is "die quenched," and remains true, without warpage. The 4130 X steel, thus quenched to 440 Brinell is then tempered slightly, to around 400 Brinell, and chromium plated. Nitriding is also being considered. This gives a wear resisting blade. A 13 ft., 3 bladed propeller weighs 140 lbs. against 260 lbs. for duralumin. Magnesium propellers show weight and performance advantages over duralumin in all sizes, and in the larger sizes, the hollow steel has a decided advantage over magnesium. HWG(9)

Aluminum Alloys Used in Commercial Motor-Vehicles. Discussion of FRANK D. GOLL's Transportation Meeting Paper. *S. A. E. Journal*, Vol. 28, Feb. 1931, pages 215–217.

Discussion of Al for commercial motor-truck bodies and tanks. Statement that commercially pure Al is seldom used for structural parts except when alloyed with another element or elements such as Cu, Mn, Mg or Si. Comments upon new alloys availab e. Author considers subjects of design, selection of a correct Al alloy for a particular purpose and like matters. Advantages of Al bodies as to weight saving, low maintenance-cost, residual value and better appearance, are stated also, as well as special advantages applicable to certain types of body now in operation. Paper also treats Al motor-truck tanks and presents numerous statistical data in tabular form. Comments on the methods of fabrication, shop practices and design values are made in the discussion, and upon the relative cost of Al and of steel fabrication. Experience had with tanks is stated by two discussers, and some of the factors relating to fabrication costs are enumerated. Weight saving is brought out as a major factor that the tire manufacturers are dependent upon, and some further possibilities of saving weight are mentioned. Experience of one manufacturer of Al bodies is stated. See also *Metals & Alloys*, Vol. 2, April 1930, page 81. MFB(9)

Nickel Alloy Cast Iron in Automobile Industry. (Nickelgusseisen im Automobilbau.) H. OSTERMANN. *Deutsche Motorzeitschrift*, Vol. 7, July 1930, pages 340–350, 15 references.

Requirements to be met with by casting material for cylinders as strength, resistance to wear, machinability, absence of internal stresses. Properties of (a) cast iron, (b) alloyed cast iron. Influence of Ni and Ni + Cr additions upon quenching strains, specific gravity, resistance to wear, thermal expansion. Application of Ni-alloyed cast iron. EF(9)

Chromium as a Printing Surface. GEORGE B. DRACH (Jersey City Printing Co.) & LOUIS WEISBERG (Weisberg and Greenwald). *Metal Industry*, N. Y. Vol. 29, May 1931, page 195.

Abstract of paper read before the American Society of Mechanical Engineers, March 16–17, 1931. A half-hour chromium deposit on printing surfaces holds up for as many as 1,800,000 impressions without requiring repairs or refinishing. PRK(9)

Light Iron and Wire Products. JAMES CLARK. *Welding*, Vol. 1, Aug. 1930, pages 691–692.

Describes some methods and shapes for ornamental work. Ha(9)

Lautal as New Material for Oxygen Flasks. (Lautal als neuer Werkstoff für Sauerstoff-Flaschen.) N. CHRISTMANN. *Schmelzschweissung*, Vol. 9, Dec. 1930, pages 277–281.

The manufacture of lautal-flasks is described and the government specifications (German) for guaranty tests are cited; the test methods are described and test results given. Ha(9)

Rayon and Nitric Acid Use Italy's Aluminum. Correspondence from F. GIOLITTI, Turin, Italy. *Metal Progress*, Vol. 20, Aug. 1931, pages 85–86.

The writer describes chemical applications of pure aluminum and light alloys in Italian industry. WLC(9)

An All-Metal Savoia. R. GIACOMELLI. *Aircraft Engineering*, British, Vol. 3, July 1931, page 174.

A metal version of the famous Savoia S. 55 twin hull seaplane has been constructed, and as a result an interesting comparison between wood and metal construction has been obtained. The metal seaplane, precisely the same in all respects, including equipment, as its wooden prototype, has effected a saving in weight of 1777 lbs. with a factor of safety of 9 as against 7.4. The S. 55 M is a torpedo-carrying machine, with two floats, a full cantilever plane with two engines mounted in tandem on a gantry above the center section. The whole structure is metal, constructed of rolled aluminum alloy strip with duralumin sheet plating. WAT(9)

Railroad Makes Brass Trolley Wheels. C. W. GEIGER. *Brass World*, Vol. 27, July 1931, page 157.

The Market Street Railway Co., San Francisco, Cal., build their own trolley wheels. They are doing 18,000 miles and better. A brief illustrated outline of the manufacture is given. WHB(9)

Manufacture and Testing of Steel Flasks According to Police Regulations for Liquified and Compressed Gases. (Die Herstellung und Prüfung von Stahlflaschen nach der Polizeiverordnung für verflüssigte und verdichtete Gase.) ALEX MATTING. *Die Schmelzschweissung*, Vol. 9, Oct. 1930, pages 232–236.

The great economy in transportation of gases by liquefying and compressing has created a great demand for steel flasks which are used in almost all countries for this purpose. The different methods of manufacturing the steel flasks from seamless tubes or hollow blooms or ingots by the Mannesmann, Pilger and Everhardt processes are discussed and the respective advantages pointed out. The flasks have, usually a diameter of not more than 210 mm. and a length of 2 m. and are, in all countries, subject to certain guaranties. In Germany, a material of more than 41 kg./mm.² tensile strength and an elongation of 12% for 100 mm. test length is required. The testing methods are described in detail, extending not only to the material of the flask but also to the gases with which the flask is filled. Comparative data for England, America, Switzerland and Japan are given. 7 references. Ha(9)

Vanadium in Iron Industry. (Das Vanadin in der Eisenindustrie.) PETINOT. *Korrosion und Metallschutz*, Vol. 6, Sept. 1930, page 207.

Briefly refers to the paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. See "Vanadium Additions Improve Steel," *Metals & Alloys*, Vol. 2, Aug. 1931, page 154. EF(9)

Dependability in Propellers. RAYCROFT WALSH. *U. S. Air Service*, Aug. 1931, pages 36–37.

The author is president of the Hamilton Standard Propeller Corporation. The article is a brief survey of the development and tests of aircraft propellers. Metal propellers are subjected to a so-called whirl test, usually of 10 hours duration at 300% overload of rated capacity. In one case an entirely new design of a new metal successfully withstood 600% overload on the whirl test. In the old wooden propeller a 50% overload was considered ample. A considerable number of standard type propellers have been flown more than 2500 hours in commercial service. Tests at Wright Field now in progress and incomplete indicate so far that long use shows no loss in strength. Experience has shown that the early removal of nicks and careful periodic inspection by a trained personnel is very essential, for fatigue failures often start from a very small nick or scar on the surface of the blade. The present stabilized design is about to give way to really important propeller developments involving greatly increased efficiency and much lighter weights. Forced magnesium and hollow steel propellers will permit the general adoption of the large propellers required for geared motors, with their consequently increased cruising efficiency. When these blades are used in a controllable pitch propeller, the last obstacle will be removed to the use of geared motors. When the blades of these propellers are turned to the low pitch position, the unfavorable take-off characteristics inherent to the use of geared engines can be changed into a marked improvement over the take-off obtained with direct-drive motors. WAT(9)

The Use of Special Non-ferrous Metals and Alloys in Marine Engineering and Shipbuilding. J. W. DONALDSON. *Metallurgia*, Vol. 4, July 1931, pages 77–80.

Non-ferrous alloys are used in ship construction on account of their resistance to corrosion. Alloys for condenser tubes, turbine blades, engine parts and their uses are discussed. 4 references. JLG(9)

A New Coinage Metal, Forgery Detected Without Analysis. M. CHIKASHIGE & S. UENO. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 61–64, 5 figures.

Heat-treatable alloys of 63–71% Ag, 28–36% Zn, and 1/2 to 5 1/2% Cu are doubled in hardness by quenching. Depending on composition the quenching temperature ranges from 650° to 240° C. Part of the ternary equilibrium diagram is shown. These are suggested for coinage. Heat treatment and hardness determination of a suspected coin would show whether it was of the coinage composition or not. HWG(9)

Aluminum Casting for Diesel Motors. (Aluminiumguss in Dieselmotorenbau.) W. HARTL. *Automobiltechnische Zeitschrift*, Vol. 34, Feb. 16, 1931, pages 94–98.

The heavy cast parts of Diesel engines may be replaced by lighter aluminum alloys on the following principles: The alloy involved shall possess good casting properties. The amount of shrinkage shall be sufficiently low to prevent the formation of cracks during solidification. The alloy shall be tough at higher temperatures. The engine parts having a direct contact with cooling water and combustion gases shall be corrosion-resistant. Owing to lower E-modulus, impact and fatigue value of aluminum alloys, the rigidity of engine parts shall be increased by proper design. Ample space is devoted by the author to this question and stress diagrams are drawn for various designs. Silumin or its derivative containing 0.8% Cu and 0.3–0.6% Mn seems to meet most of the cited requirements to a greater degree than other aluminum alloys. Also, aluminum alloys containing more than 1% Cu and Zn can be used but not in parts exposed to casting water or combustion gases. ER(9)

Nirosta and the Chrysler Building. (Nirosta und Chrysler-Bebäude.) SCHARSCHMIDT. *Krupp'sche Monatshefte*, Vol. 12, May 1931, pages 112–117.

The article gives an illustrated description of the application of Nirosta in building construction and deals with its use in some cases of modern structures in the United States and in Germany. GN(9)

The Use of Nickel as a Catalyst for Hydrogenation. HOMER ADKINS & HOWARD I. CRAMER. *Journal American Chemical Society*, Vol. 52, Nov. 1930, pages 4349–4358.

The preparation of a reasonably active nickel catalyst is described and experimental details are given for the satisfactory reduction of 45 representative organic compounds. MEH(9)

The Life of Metallic Tubing Subjected to Vibration. R. L. TEMPLIN. *Automotive Industries*, Vol. 65, July 11, 1931, pages 50–52.

Metallic tubing such as is used for air, gas and oil lines in airplanes, automobiles and other machinery must frequently withstand vibrational stresses under the service conditions imposed. The magnitude of the stresses caused by vibration under service conditions is rather difficult to evaluate It must be emphasized that the designer of a structure or machine involving the use of such tubing is to a large extent responsible for the proper installation of the tubing so that it will be subjected to a minimum amount of vibration during service, and if vibration occurs, the resulting stresses will be as small as possible. Many of the vibrational failures noted in the past can be directly traced to improper design of the supports or fastenings applied to the tubing. (9)

Applications for Metallic Gaskets. F. W. SYLVESTER. *Heating, Piping & Air Conditioning*, Vol. 3, June 1931, page 472.

A type of metallic gasket which appears to be particularly useful in making up joints with flanges that are not quite true is the corrugated metal gasket made up of a single sheet of metal with the corrugations on both sides filled with asbestos cord. This type of gasket has been successful in marine oil pumping systems where the working pressure has been 750 lbs./in.^{2} WAT(9)

Strong Steels for Bridges. D. B. STEINMAN. *Metal Progress*, Vol. 19, June 1931, pages 33–39.

The author outlines the service the bridge designer expects of the metallurgist in the way of dependability, high strength, low cost steels. Applications of various alloy steels are illustrated and discussed. Properties of the common high strength steels used are tabulated. Comparisons of cost of several materials are made. Fifteen considerations for the metallurgist and bridge designers are listed amongst which are high strength, freedom from fabrication difficulties, uniform dependability and coöperation in the design of the newer and larger bridges. WLC(9)

Pennsylvania Adopts 152-lb. Rail. T. J. SKILLIMAN. *Railway Age*, Vol. 91, Aug. 8, 1931, pages 205–206.

The author is chief engineer, Pennsylvania Railroad System. The demand for greater stiffness and longer life under increasing axle loads and higher speeds are met by the design of this heavy section. The first heats were laid in May and June 1931 on the New York Division between New York and Pittsburgh. The object of this design is to satisfactorily and safely withstand an axle load of 100,000 lbs. moving at a speed of 100 miles per hour. This contrasts with an axle load of 80,000 lbs. moving at a speed of 80 miles per hour which was the service for which the 130-lb. rail was designed that has been standard on the Pennsylvania since 1916. The height is 8 inches (1 3/8 inches higher than 130-lb. rail). It is estimated that this change in design will meet the speed and loading requirements for the next 25 years. A definite desirable ratio of the perimeter of each part of the rail, that is, the web and the base and the head, to their respective volumes, so that the rate of cooling of all of these parts should be as nearly even as possible, in order to minimize the creation of internal stresses as a result of cooling. A provision is made for canting the rail, and that this should be done in the ratio of 1:40 by the use of a canted tie plate, as a further means of insuring a better contact between head of the rail and the tread of the wheel. WAT(9)

Seamless Steel Tubes for Aircraft. AUSTYN REYNOLDS. *Aircraft Engineering*, British, Vol. 3, June 1931, pages 141–145.

The article is a description of the manufacturing processes employed in the Reynolds Tube Company, Ltd., and describes the materials and their qualities. A new machine for proof bend testing of tubes is described and illustrated. WAT(9)

Applications of Stampings in Aircraft Construction. H. G. RUNDE. *Metal Stampings*, Vol. 3, July 1930, pages 637–638.

From paper read before the American Society for Testing Materials, June 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. MS(9)

Developments in the Manufacture of Lead-Covered Paper-Insulated Telephone Cable. J. R. SHEA. *Bell System Technical Journal*, Vol. 10, July 1931, pages 432–471.

All the various stages of manufacture are discussed. The sheathing of the cable and the melting of the PbSb alloy are briefly but interestingly described. HWG(9)

The Application of Steel Pipes as Structural Parts for Automobiles. (Die Verwendung von Stahlrohr im Automobilbau.) W. REINECKE. *Automobiltechnische Zeitschrift*, Vol. 34, Jan. 10, 1931, pages 11–13.

The introduction of front wheel brakes implies a need for new design of front axle, which will resist the torsional stress better. The tube front axle would meet this requirement adequately. According to stress diagram, the torsional strength of tube axle of 4.43 and 11.12 cm.^{2} in cross section would be 9 and 24 times higher than that of double-T-axle of equal cross section. The wide application of tube front axle has been restricted by not having at hand the proper economical ways of fixing spindle arm and spring clips to axle. The tube-frames, as employed by Tatra, Austro-Daimler, Faudi and Harris Leon Laisne cars, may also find a wider use. The standard U-frame system does not possess sufficient diagonal strength; this can be overcome by the use of tube-frames. The recent state in development of welding technique would supply cheap and simple means of joining separate tubes together into a rigid frame system. ER(9

Aluminum Busbars Resist Power Arcs. J. D. PORTER. *Electrical World*, Vol. 98, July 18, 1931, pages 104–105.

Experiments indicate that the aluminum arc is comparatively unstable and does less damage to the aluminum surface because of the arc's lack of concentration. Illustrations are shown of Al and Cu busbars tested under power arcs. WHB(9)

A New Weld-Flange Joint for Gas and Water Pipes. (Eine neuartige Schweiss-Muffenverbindung für Gas- und Wasserleitungen.) E. KALISCH. *Die Schmelzschweissung*, Vol. 10, May 1931, pages 108–109.

A flange with a long collar which is filled with packing to about 1/2 or 2/3 and then the outer part bent down over an iron ring packing and welded. Tested from a welded-on outlet by high pressure (50–80 atmospheres) the strength and tightness can be easily proved and at the same time the packings are pressed together very tightly. Ha(9)

Construction and Manufacture of Steel Wire Rope. G. C. HODGSON. *Canadian Mining & Metallurgical Bulletin* No. 231, July 1931, pages 816–821.

The range in the composition of steel used in the manufacture of wire rope is carbon 0.4–0.9%, Mn 0.4–0.8%, S not over 0.04%, and P not over 0.04%. Specifications for physical tests are also given. Crucible cast steel, extra-strong crucible cast steel (mild plow), best plow and best improved plow are used (order of increasing tensile strength). AHE(9)

85,000 Chromium-Plated Gages Used in Ford Plant. C. O. HERB. *Machinery*, Vol. 37, July 1931, pages 817–821.

The engineers of the Ford Motor Co., Dearborn, Mich., conducted an extensive investigation into the advantages obtainable by using gages plated with chromium. When it was found that in certain grinding operations, chromium plated gages could be used 218 hours, as against 4 hours for tool-steel gages, it was decided that chromium-plated gages should be used whenever possible. The manufacturing departments had to be sold on this idea, but the results of hundreds of tests were convincing, and the practice has now been followed with complete success for more than two years. Furthermore, it has been adopted in all plants of the company. The Ford Motor Co., therefore, chromium-plated gages to lengthen their life, and thus substantially lower inspection costs. The gage wear limit has been established as 20% of the difference between the minimum and maximum dimensions. For example, if the specified tolerance on the part is 0.002-in., the wear limit on the gage would be 0.004-in. The most important economy effected by the adoption of chromium-plated gages has been in inspection costs, which have been reduced, in many cases, one-half and in some instances even more. The greatest savings have been made on applications where the specified part limits are close. (9)

Crane Built of Strong Aluminum Alloy. F. V. HARTMAN & E. C. HARTMAN. *Iron Age*, Vol. 125, June 5, 1930, pages 1689–1690; *Metallurgist*, July 1930, pages 99–100.

Describes a 10-ton Al traveling crane of the United States Aluminum Co., Massena, N. Y. It is a 3-motor single-hook crane with a lift of 22 ft. The girders of Al alloys, have a span of 72 ft. 2 in. The Al alloy girders were constructed with section deeper, wider and of greater sectional area, due to the difference in modulus of elasticity between Al and steel. Compares Al crane with a steel crane. See *Metals & Alloys*, Vol. 1, July 1930, page 630. VSP+VVK(9)

New Airships Use Stronger Metals. JOHN F. HARDECKER. *Metal Progress*, Vol. 20, July 1931, pages 37–44.

Development of light strong alloys for airship applications are described and properties given and discussed. WLC(9)

Recent Progress in the Industrial Application of Alloy Steels. R. HADFIELD. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 1–24.

Account of the achievements of Hadfield and his firm. What little actual data are given refer to trade-named steels. HWG(9)

Dimensional Changes in the Manufacture of Electrotypes. N. BEKKEDAHL & W. BLUM. *Bureau of Standards Journal of Research, Research Paper* No. 308, Vol. 6, May 1931, pages 829–845.

The different operations in the electrotyping process produce the following changes in dimension and must be controlled accordingly to produce plates with uniform dimensions. 1. Molding. Wax molds are almost exactly the same size as the originals. Lead molds are slightly larger (about 0.05 per cent) than the originals. No special precautions are required to produce uniform plates by either method of molding, but plates made by the two methods are not likely to match each other exactly. 2. Depositing. When copper shells are deposited from cold solutions there is a slight contraction (about 0.05 percent). The use of warm solutions at a high-current density produces the desired hardness with no appreciable change in dimensions. Nickel-copper shells always contract by about 0.15 percent. This value is not affected by increasing the thickness of copper and nickel. Such a change in thickness does, however, materially affect the stretch in curving. It is therefore important to keep the conditions for nickel and copper deposition constant, and to produce shells of uniform thickness and strength. 3. Casting. Casting always causes a shrinkage of about 0.15 percent, which is not much affected by the temperature of casting or the rate of cooling. Any large change in composition of the electrotype metal will affect the shrinkage. Shrinkage is decreased by increasing the thickness of the shells. 4. Finishing. Hand finishing always stretches the plates, by amounts that vary with the extent of the finishing operation. Straightening under pressure at ordinary temperature also stretches the plate, but more uniformly than does hand finishing. Straightening in a hot press causes a contraction of about 0.10 percent. 5. Curving. The stretch of plain plates in curving is usually less than that calculated from the formula for a homogeneous plate; and a type form stretches more than calculated. Hot curving may produce a slightly greater stretch than cold curving. With a given method, most uniform results are obtained when the shells are of the same thickness and strength and have the same type of pattern, and when the electrotype metal is of the same composition. The temperature of casting and rate of cooling of the electrotype metal have little, if any, effect on the stretch in curving.

In curving by the "nonstretch" method, it is possible by adjusting the thickness of metal cast upon the face of the plate to reduce the stretch to approximately zero. If too much metal is applied, shrinkage may be produced in curving. WAT(9)

HEAT TREATMENT (10)

Effects of Prequench Treatments on the Hardness, Body and Structure of Hardened Tool Steel. R. H. HARRINGTON (General Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 404–422.

Paper presented before the Twelfth Annual Convention of the Society. Includes discussion. The paper is illustrated with 7 charts and 18 micrographs. Body is defined as the ability of steel to take repeated quenching without failure. The difficulties in the treatment of small dies in quantity were the subject of this study. To obtain the best results a pre-quench treatment is recommended. For maximum hardness an air-normalize from 900° C. (1650° F.) followed by water-quench from 800° C. (1470° F.) and a draw from 200° C. (390° F.) is recommended, for maximum body an anneal from 750–800° C. (1380°–1470° F.) followed by water quenching from 750° C. (1380° F.) and for combination of high hardness and good body an oil quench from 850° C. (1560° F.) is recommended. In discussion G. V. Luerssen, Carpenter Steel Co., mentions the inherent characteristics of the steel as related to body and suggests the study of the body of steels of widely different characteristics. S. L. Hoyt, General Electric Co., states that body increases with the percent Swedish iron in the crucible charge, with the time of working, and with decreased size of melt. WLC(10)

Heat Treating Gears Made of Armor Plate. ROBERT E. BULTMAN. *Metal Progress*, Vol. 19, May 1931, pages 70–74.

The author discusses the machining properties and heat treatment of the Krupp steel of 1.20–1.70% Cr, and 3.80–4.30% Ni for carburizing. Due to toughness, special treatment is necessary to make the material machinable. Service results have shown that in spite of the added cost of the treatment its use is justified in heavy duty trucks and busses. Application of 5% Ni carburizing steel to truck transmission gears is also discussed. WLC(10)

Practical Considerations on Hardening. (Praktische Härtereifibel.) V. FABIAN. V. D. I. Verlag, Berlin, 1930. Paper, 6 × 8¼ inches, 92 pages. Price 5 RM.

This is an attempt to describe to non-technical workmen the proper methods of hardening tool steels. Fabian states that whatever its chemical composition, when a steel specimen reaches its own transformation temperature, blisters appear to rise up on its surface, and that this phenomenon and the correct hardening temperature coincide. Throughout the book, the statements made are of about the same order of accuracy.

Fracture tests are described and crude sketches of fractures given, by which to determine with what sort of tool steel the blacksmith is dealing. Spark tests are briefly described. Martensitic and other structures are referred to quite often, but are not illustrated, save by sketches showing where hardened zones will occur, and are not described sufficiently for the non-technical reader to get much of an idea of them. Hardening and drawing temperatures are often referred to in degrees, but it is obvious that the the author would be surprised if his readers had a pyrometer. He does urge them to familiarize themselves with some hardness tester.

A good many practical kinks as to suitable precautions to avoid distortion and cracking are given. The suggestions are based on good scientific bases, but it is hard to see how a workman could be expected to get good results without closer control of temperature than he would be able to apply if he is working in a shop as badly handicapped by the lack of pyrometers as the type of shop the author seems to be writing the book for. The book would have been of some value to the average heat-treater if he had only the equipment of 25 years ago. It would not be particularly helpful to workmen in modern plants.

One gathers that glycerine is a fairly common quenching medium in small German hardening rooms, as it is often mentioned as an alternative to oil.
H. W. Gillett (10)-B-

Heat Treatment Determines Properties of Manganese Steel. HARRY P. EVANS. *Steel*, Vol. 87, Sept. 11, 1930, pages 66, 68.

Abstract of paper read before the American Foundrymen's Association. Explains mechanism of changes which confer special properties on manganese steel. Low manganese steel, if properly treated, will give physical properties comparable to more complex alloy steels. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 900. MS(10)

The Machining of Stainless Steel. R. WADDELL & F. WORTON. *Aeroplane*, England, Vol. 40, Apr. 29, 1931, pages 784, 786, 788, 790; *Machinery*, London, Vol. 36, Jan. 8, 1931, pages 491-493.

An abstract of a paper read before the Institute of Production Engineers and before the Yeovil Branch of the Royal Aeronautical Society. Stainless steels contain varying amounts of Cr, generally upward of 10%. Brearley steels (martensitic) are all more or less hardened by heat-treatment and are magnetic. They are here subdivided into: (1) steels with .15–.35% C and 11.–14.% Cr, (2) steels with less than .15–.35% C and with 13.–16.% Cr, and (3) steels with less than .2% C, 16–20% Cr and 1.5–2.5% Ni. Type (1) is the cheapest on the market and offers least resistance to general corrosion, (2) steel are softer, more expensive and more resistant than (1), and (3) steels are slightly harder than (2) but softer than (1). They are much more resistant to general corrosion and particularly so toward seawater. Strauss (Krupp) steels (austenitic) are not hardened by heat treatment but are by cold work—an undesirable feature. They are non-magnetic, except in the work-hardened state. They have a low elastic range, in their normal state, but are more highly resistant to general corrosion than the Brearley steels. Some special variants withstand attack from even sulphuric acid. At present, all stainless steels are more difficult to machine than the mild steels and brass. Warpage is often encountered and is caused either by the release, on machining, of internal stress locked up in the material or by the setting up through rough machining, of differential stresses in the material. Curves show a heating and cooling curve of a low time-rate and of a quick time-rate (corresponding to hardening condition) and a comparison shows that the cooling range has been shifted to a much lower temperature (250°) and the amount of expansion greatly increased, simply by accelerating the rate of cooling. An air hardening diagram shows that the time-lag (in reaching any given temperature) between the surface and the center is not great and that the volumetric change takes place in both positions at about the same temperature. The water hardening diagram reveals a considerable time-lag between the surface and center curves and a wide divergence in the temperature at which the volumetric change takes place. Time-lag and temperature difference operate in the same direction, to produce severe internal stresses and the trouble becomes progressively more formidable with increasing dimensions of the object being hardened. Tempering relieves these to a greater or less extent. Fine finishing cuts are best for stainless steel as distorted surfaces greatly weaken the resistance of the steels to corrosion. Distortion of the surface material renders it electro-positive to the undistorted material below it. Both groups of stainless steels tend to seize or stick in sliding contact with each other, making it desirable to avoid rubbing contacts wherever possible. Conclusions drawn are: (1) cold work stresses in ordinary carbon- and alloy steels and in the martensitic stainless steels may be reduced by tempering at 550–600° and to a less extent by prolonged tempering at lower temperatures, (2) hardening stresses are least in the air-hardening steels, greatest in the water-hardening, with the oil-hardening lying somewhere between, (3) hardening stresses can be reduced or removed by tempering, (4) machine stresses can be reduced by careful centering, by the use of light cuts and sharp cutting tools, and by periods of rest between cuts. WHB(10)

Deformations Accompanying Thermal Treatment of Steel. (Nouvelles recherches concernant les déformations accompagnant les traitements thermiques de l'acier.) PORTEVIN & SOURDILLON. *Revue de Métallurgie*, Vol. 28, June 1931, pages 348–365; July 1931, pages 379–390.

Besides the usual physico-chemical and structural changes occurring in heat treatment of metals, deformations, internal straining, cracking, etc. present a new field of investigation of great interest but difficult of approach as being a function of anisothermy affected by the shape of the sample. In a previous paper (*Revue de Métallurgie*, Vol. 24, page 215) the question was approached from the standpoint of annealing and quenching. It was found that annealing reduces the length and increases the diameter of the cylindrical test pieces which is more pronounced the higher is the temperature and the faster is the cooling. The increase of diameter is more pronounced at the center than at the edges. Quenching of specimens from a temperature at which they have a considerable viscosity produces an insignificant change in their dimensions, which increases somewhat with the rise of temperature and then rapidly as soon as transformation temperature is reached both for martensitic and austenitic transformations. The former causes the changes opposite to those observed at lower temperatures while, at austenitic transformation, a contraction of both dimensions is produced which is able either to reduce, neutralize or even reverse the results of the former. In a general case, the curve has 3 branches the position of which, for geometrically identical samples, depends on the critical temperature of quenching inherent in a given steel. Knowing the shape of these curves, it is possible to harden a steel by quenching it from a temperature which will not produce any changes in dimensions when the specific properties of a steel permit it. Secondary phenomena inevitably occur during these changes more or less pronouncedly according to the energy of cooling and intervention of other factors, such as thermal conductivity of the metal, all of which affect anisothermy, becoming larger the greater is the critical quenching temperature of the alloy. Higher cooling speeds always increase the amount of deformation. The amount of strain in the metal before quenching does not have any appreciable influence. Annealing before quenching entirely eliminates the influence of any previous treatment while the time of heating for quenching has no effect whatever. Uniformity of cooling is obligatory; otherwise distortion inevitably occurs. The repetition of similar treatments causes additive dimensional changes. Drawing produces progressive transformations in the metal and its effects are additive. A rapid contraction takes place on drawing quenched specimens at 300° reaching a maximum at 600°. By drawing at the same temperature specimens hardened at different temperatures, particularly when austenitic quench was obtained, it is possible to obtain either a considerable elongation or contraction depending on whether martensitic or austenitic transformation is taking place. Some applications of these principles to the heat treatment of cluster gears and other automobile parts are given. JDG(10)

Hardening (10a)

Some Sources of Variation in Hardening Practice. H. J. FRENCH. *Houghton's Black & White*, Vol. 4, July 1931, pages 4–8.

The uniformity of hardening depends, to a great extent, on the surface of the articles to be hardened. Experiments were made to show the influence of rough surfaces on the cooling. Where possible, a separation into groups of similar articles is recommended to insure equal hardness by the same treatment. Ha(10a)

The Hardening of a Special Chrome-Vanadium Steel. (Estudio del temple de un acero especial al cromo-vanadio.) J. NAVARRO ALCACER & G. GAYOSO. *Revista de Ingenieria Industrial*, Vol. 2, Jan.-Feb. 1931, pages 7–10.

The Cr-V steel contained: C, 0.45–0.50%; V, 0.3–0.5%; Cr, 1–1.2%. It had an average hardness of 174 Brinell and 87.5 Rockwell. The critical point was found at 720° by a heating curve and 620° by a cooling curve. Hardening by heating to 850° and oil quenching produced a Brinell hardness of 470. With an increase in temperature to 1000°, the hardness increased to 482. WHB(10a)

The Deep Hardening of Structural Steels with Special Reference to the Influence of Cross-section of the Piece and Composition. (Die Durchvergütung von Konstruktionsstählen unter Berücksichtigung des Einflusses von Stückquerschnitt und Legierung.) H. KALLEN & H. SCHRADER. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, pages 387–388.

This abstract corresponds to the original paper in *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 383–392. See *Metals & Alloys*, Vol. 2, July 1931, page 132. GN(10a)

On Temper-Brittleness in Steel. S. MAITA. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 227–237.

In English. Includes discussion. A 0.54% C, a 0.30% C, 3.29% Ni, 0.59% Cr, and a 0.29% C, 2.93% Ni, 0.70% Cr, 0.86% Mo steel were compared by: (a) oil-quenching all from 850° C.; (b) quenching the carbon steel from 760° C. and the other two from 730° C., tempering all at 650° C. one hour and (a) furnace cooling, (b) oil quenching. On the carbon steel, slow cooling from the draw after high temperature quenching dropped the Izod from 20 ft.-lbs. to 14; after the low temperature draw it raised it from 20 to 25. On the Ni-Cr steel it dropped the Izod after high temperature quenching from 65 to 21; after low, from 71 to 66. On Ni-Cr-Mo it dropped it from 45 to 43 after the high temperature quench, and from 56 to 55 after the low temperature. Low temperature quenching is, therefore, advised. It was admitted that tensile and yield were not as good with the low temperature quench, but no figures were given. HWG(10a)

Heat Treated Rail Ends Resist Batter. M. D. BOWEN. *Metal Progress*, Vol. 19, Apr. 1931, pages 33–38.

The author describes end batter in rails and the former practice of welding onto the ends of the rails new material to take out the depression. This practice suggested that a hardening of the rail-ends by heat treatment might make the rail more resistant to end batter and eliminate some of the maintenance costs due to this cause. After some experimenting and with careful control, a technique has been developed for the heat treatment of rail ends rendering them almost immune to end batter. A special thermocouple device used to check the treating temperatures is described. WLC(10a)

Annealing (10b)

Annealing Cartridge Cases. B. W. BENEDICT. *U. G. I. Circle*, Vol. 11, Sept. 1930, pages 5–10.

The cartridge of the Springfield rifle, caliber 30, is made of brass of 70% Cu and 30% Sn. The process of manufacture and treatment is described in detail. It shows an unusual distribution of tensile strength: at the head 60,000 lb./in.², increasing to 70,000 lbs. at about ¾ in. further, then decreasing to about 40,000 lb. at the mouth. This is brought about by cold work and annealing operations. Ha(10b)

Case Hardening & Nitrogen Hardening (10c)

Behavior of Liquid Carburizing Baths. E. C. MOFFETT. *Iron Age*, Vol. 127, Apr. 23, 1931, pages 1338–1341.

Cyanide concentration of about 30% gives good penetration and hardness on low C steel. Use of temperature in excess of 1550° F. results in the deterioration of cyanide and does not increase the rate of penetration. NaCN and $Ca(CN)_2$ are used for liquid carburizing. Five general rules are given for using NaCN. Aerocase process consists of using molten salt bath Aerocase compound No. 510, to which is added small amounts of activating material. This is also known as $Ca(CN)_2$ method. Compares the 2 methods and gives results of investigations. VSP(10c)

An Appraisal of Nitriding. M. A. GROSSMANN (Republic Research Corp.). *Preprint* for May 1931 meeting, *American Iron & Steel Institute*, 10 pages; *American Metal Market*, Vol. 38, May 23, 1931, pages 3, 10; *Heat Treating & Forging*, Vol. 17, June 1931, pages 570–572, 575; *Iron Age*, Vol. 127, June 4, 1931, pages 1823–1826.

Review of progress since publication of Fry's A. S. S. T. paper in 1929. Eleven points then made by Fry are examined in the light of later knowledge. Newer practice may nitride first at 950°, and then at 1150–1200° F. to produce a thicker case. The case retains hardness at higher temperatures than it was previously supposed. For rust resistance, the outer skin of the case must not be removed. Free ferrite or surface oxidation must be avoided. Theories to account for the hardness of the case are still unsettled. It is suggested that Al, Cr, Mo and V, especially Al, form nitrogen compounds agglomerated to some degree and very finely dispersed in ferrite. The particle size is important and is dependent on nitriding temperature. If nitriding is started at too high a temperature, high hardness is not obtained. Nitriding pots deteriorate through some unknown mechanism in such manner that the efficiency of nitriding, on the work contained in them, decreases. An alloy of 25% Cr, 20% Ni, 55% Fe, or an enameled container, act the best. Nitriding steels can be welded by atomic hydrogen and the weld nitrided to 800 Brinell. Nitrided cases are not suitable for service in mineral acids, in clash gears or in sand-blasting nozzles. HWG+DTR(10c)

Hardening Steel Commercially by Cyaniding Process. E. F. DAVIS. *Steel*, Vol. 87, July 17, 1930, pages 43–46, 60; July 31, 1930, pages 47–48, 53; Aug. 14, 1930, pages 48, 50, 52.

Describes history of cyanide, properties and advantages of the various grades, and the mechanism of the hardening process. Discusses brittleness of cyanided work and its relation to the cyaniding temperature and quenching methods, cyaniding gears and wire, and advantages and disadvantages of the process. Treats of the relative merits of gas, oil and electric furnaces for cyaniding aerocase method, fume prevention, cyanide poisoning, and testing of the baths. Cyanide content of an operating bath should never be below 15% NaCN. Cyanided case usually contains 0.50–0.70% C, and 0.60–0.80% N, the latter being responsible for the hardness. Depth of penetration is governed by mass, time, temperature and percentage of cyanide in the bath. Brittleness frequently is caused by quenching the steel from cyanide at a temperature below the refining heat of the core. Majority of automobile gears are cyanided, this treatment being given to steels of SAE 2345, SAE 3250, SAE 6145 and SAE 5150 analyses. Three methods are used: (1) preheating to 1250° F. and finishing the heating cycle in cyanide; (2) cyanide dip or cyanide wash method whereby the steel is heated to the hardening temperature in a rotary or hump furnace and transferred to a molten cyanide bath held at some definite temperature from 1450° to 1500° F., and (3) direct process which consists in placing cold gears in the cyanide and bringing them up to heat in the molten bath. Steels which are austenitic, such as carburized 5% Ni and 3.5% Ni steels are not hardened as successfully in cyanide as the C-Cr and Cr-Ni steels. Gas furnaces are the best and most economical. Author has developed a continuous automatically-controlled, gas-fired cyaniding furnace. Rotation of a screw carries the work through the furnace Cast-steel pots are the best for gas- or oil-fired furnaces. Alloy pots are preferable for electric furnaces. MS(10c)

Mechanism of the Tempering of Martensite. P. CHEVENARD & A. PORTVEIN. *Comptes Rendus*, Vol. 191, Dec. 1, 1930, pages 1059–1062.

The phenomena of tempering are complicated by the simultaneous presence of austenite and martensite and the difficulty of obtaining the latter in a pure state. The proportion of austenite was estimated by the dilatometric method and conclusions were thus drawn as to the behavior of martensite itself. The following changes are taking place simultaneously: Martensite ⟶ cementite + martensite (with less C); Austenite ⟶ cementite + austenite (with less C); Austenite ⟶ cementite + martensite. Some of the physical changes are plotted against the tempering temperature, simultaneously with pure martensite and quenched steel. The hardness increases at first due to the fineness of the precipitated cementite particles and the increasing concentration of C in the α-phase, but on further increase of temperature it decreases rapidly due to the coalescence of the cementite particles. The hardness of the martensitic structure, therefore, passes through a maximum. As austenite is much softer than martensite, the curve of quenched steel is approximately parallel to the one of martensite in the beginning, but it approaches the latter with an increase of temperature due to the decomposition of austenite and merges with it when the change is completed. A similar conformity appears in the dilatometric curves, and should also exist for other physical and chemical qualities. The corrosion by acids, for instance, is a function of the content of C in the α-phase, which decreases with rising temperature, and also a function of the number of cementite particles which passes through a maximum. A maximum of coloration with etching reagents is predicted. (10c)

Carburizing Alloy Rivet Snaps. ARTHUR S. REARDON. *Metal Progress*, Vol. 19, June 1931, pages 49–53.

Breakage and design of rivet snaps are discussed. The erection of the Sydney Harbor Bridge was the occasion for difficulties described. A Cr-W steel, .38–.45% C, 1.10% Cr and 2.5% W was adopted at first. Softness and bad breakage traced to high Si content resulted in a search for a new steel. Case hardened $3^1/_2$% Ni steel was tried with excellent results. A Cr-Ni steel of .12–.18 C, 4.0–4.5% Ni and 1.0–1.4% Cr carburized for seven hours at 1690° F and cooled in the box, quenched from 1620° F., for the core, and 1400° F, for the case, in water was finally used. Case depth of $^3/_{32}$ in. was obtained. Three recuttings and recarburizings were possible with these snaps resulting in a life of 8000 rivets. WLC(10c)

The Progress in Nitriding of Steels. (Les progres de la nitruration des aciers.) LEON GUILLET. *Revue de Métallurgie*, Vol. 28, May 1931, pages 265–267.

The original 1.0% Al and 1.5% Cr steel was not improved until now. Small additions of other elements are helpful, but large ones interfere with the nitriding. Ni above 5% limits nitrogen absorption, and 20% prevents it entirely which makes high Ni steels suitable for nitriding chambers. Without Al no composition permits obtaining Vickers hardness of 1100–1200. Carbon is controlled by the desired properties of the core. Tinning is the simplest and best method for prevention of nitriding of desired areas. JDG(10c)

New Method of Speeding Nitriding. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 19, May 1931,, pages 86–87.

The writer recounts experiments in which steel attached to a rapidly vibrated plate became much more reactive to its surroundings. Nickel-chromium-molybdenum steel nitrided to a depth of .014 inches in less than 9 hours at 932° F. with a hardness of 1033 Vickers. Gray cast iron became decarburized to a depth of .003 inches and covered with a sooty deposit after 10 hours at 530°. Vibration obtained with a magnetic oscillator. WCL(10c)

On the Nitrification (Nitriding) of Pure Iron. T. TAZAWA. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 109–110.

In English. "Nitrogen penetrates into iron in sine periodic form, producing various iron nitrides which alternately form and decompose." HWG(10c)

Nitride Hardening of Alloy Steel for Diesel-Engine Use. C. R. ALDEN. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 2, 1930, *Oil and Gas Power*, pages 57–63.

Includes discussion. In this paper the author discusses metallurgical developments in the nitride hardening of alloy steels and the advantages that may be expected from increased use. With correct analysis of the steel, freedom from distortion in hardening depends upon the operations preceding nitriding. A sequence of operations is given, and nitriding equipment is described. Time necessary to produce and the cost of the nitrided product are given. (10c)

A Study of Carburization of Metals. A. A. RAVDEL. *Journal Russian Physico-Chemical Society*, Vol. 62, 1930, pages 516–522. (In Russian.)

A series of carefully made experiments was made by heating W and Mo filaments in vapors of naphthalene. Using 0.06 mm. $C_{10}H_8$ vapor pressure and heating W filaments several scores of times for different intervals it was found that their conductivity, measured at room temperature, reached a minimum and then rose to about 40% of the original conductivity, where it remained regardless of further heating. The amount of C absorbed was measured by determination of H pressure formed in the decomposition. The formation of W_2C was not complete, carbide and metal were always present together. Its production was possible on the reduction of $C_{10}H_8$ vapor pressure to 0.0015 mm. The speed of decomposition reaction and that of formation of carbides depends on the pressure and temperature, particularly when the penetration of C into the metal is slowed up by the presence of a superficial layer of carbides. In case of Mo the relation between conductivity and carbon content is different from W and is further complicated by the formation of several carbides only 2 of which, Mo_2C and MoC, were identified on the conductivity curve. (10c)

Present Status of Solid Carburizers. STANLEY P. ROCKWELL. *Iron Age*, Vol. 127, Mar. 26, 1931, pages 1009–1010, 1065.

A symposium conducted by the New York chapter of the American Society for Steel Treating. Early methods of applying bone and leather and gradual development of commercial carburizers are considered. Solid carburizing is a major heat treating operation. One advantage of solid over gas or liquid material is when Cu plated work is to be carburized. Evidence points to gaseous material as the future carburizer, but solid materials will still be used in large quantities. VSP(10c)

Cyanides in the Case-Hardening and Heat Treatment of Steel. W. NELSON. *Metallurgist*, Feb. 1931, pages 21–23.

The cyanides of sodium and potassium have been the subject of considerable investigation. Molten cyanides can now be worked economically in the region of 950° C. Modern research and practice have shown that cases up to 0.06 in. can readily be obtained in molten cyanides; that the possibility of exfoliation can be definitely eliminated; that the degree of hardness is no greater than that obtained by any other method of case-hardening and heat treatment, and can be reduced at will without tempering. Excellent results were obtained from a bath containing 20 lb. sodium cyanide and 20 lb. sodium carbonate. Melts containing either chlorides or potassium salts depreciated much more rapidly than baths which were free from these constituents. For example, a melt containing 8 lb. KCl, 12 lb. Na_2CO_3 and 20 lb. NaCN, was maintained at a concentration of 50% NaCN by additions of a mixture of 80% NaCN and 20% KCl. At a temperature of 950° C. this bath required $1^1/_2$ lb. of this mixture per hour as compared with the all-soda bath requirement of $^3/_4$ NaCN only per hour. The penetration obtained by the 50% Na_2CO_3 and 50% NaCN at a temperature of 950° C. was a case 0.06 in. deep in 6 hours' immersion, 0.03 in. in 2 hours and 0.005 in. in 5 minutes. Exfoliation was absent. Hardness, obtained from tests over a 2 years' period, was from 58 to 64 Rockwell and 70 to 80 Shore scleroscope. Salt baths are used extensively for heat treatment. Some of the melts used have the disadvantage of decarburizing the edges of delicate components, tools, jigs, etc. The presence of cyanide in the bath prevents this decarburization. Where the steel contains less than 0.9% C the cyanide content of the heat-treatment bath must be considerably reduced, as the carburizing effect of the full strength bath would result in an alternation in the composition of the steel. In preparing a heat-treatment bath containing cyanide, nitrates and nitrites cannot be used as diluents as the reaction between molten cyanide and salts containing oxygen is explosive. VVK(10c)

Quenching (10d)

Estimation of Internal Stresses in Quenched Hollow Cylinders of Carbon Tool Steel. O. V. GREENE (Carpenter Steel Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 369–403.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, September 1930. Includes discussion, 5 references to the literature and is illustrated by 10 drawings or photographs, 5 charts and 15 tables of stress and size changes. Two appendices are attached showing the method of estimation of the stresses. The internal stresses in hollow cylinders of carbon tool steel quenched by submerged flushing are tangential tension, or a combination of tangential tension and compression at the hole. The stresses at the holes of cylinders quenched by flushing at the holes are uniformly tangential compression and increase with the quenching temperature. The latter treatment is advantageous for pressure vessels. The axial stresses at the holes were compressional in all cylinders when present. The axial compression in the outside surface of quenched solid bars decreases with increase of hardness penetration, but increases with quenching temperature except in cases of complete hardening of the section. Layers under the martensite are considerably harder when cylinders are quenched from 1600° F. and those quenched from 1450° F. Cylinders quenched by flushing at the hole are uniformly in tangential compression at the hole after tempering at 450° F. The holes of cylinders quenched by submerged flushing at 1450° F. are in tangential tension at the center and compression at the ends, which condition remains after tempering at 450°, at 1600° F. submerged flushing results in uniform tangential tension, tempering leaves the centers in tension but the ends in tangential compression. Axial stresses increase with length of cylinders but never reach values that are of consequence. The advantages of quenching by flushing at the hole rather than submerged flushing are tabulated. WLC(10d)

Aging (10f)

The Influence on Ageing of Drawing After Quenching. W. FRAENKEL. *Metal Industry*, London, Vol. 37, Dec. 12, 1930, pages 559–560.

The influence of drawing after quenching on cold and hot aging, was studied on three types of ageable aluminum alloys: (1) a duralumin-type alloy, (2) a magnesium-free alloy containing copper and (3) an alloy containing zinc and lithium. Small drawing stresses (1 to 5%) and heavier stresses (20 to 60%) were applied, and the hardness and strength—in some cases, also the ultimate tensile strength and conductivity—of the metal were tested throughout the various stages of the treatment. The author was able again to confirm the long known fact that aging is hindered, or even stopped entirely, by drawing after quenching. Although aging phenomena are still clearly observable if the drawing stress is not too pronounced, much higher strength values are usually obtained if the material is finish-drawn after the aging process has been brought to an end. This sensitiveness toward drawing stresses is not uniform with the various alloys. It is most pronounced in the alloy containing zinc and lithium. The increase of electric resistance with progressive aging, which is quite apparent in the alloys of the duralumin type, is not as pronounced in pre-drawn material, thus proceeding parallel with the corresponding decrease in the amount of finish-drawing. After describing the experimental results obtained, the author offered some theoretical observations. (10f)

The Ageing of Permanent Magnet Steels. J. E. GOULD. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 273–292.

Aging of 36% Co, 5¾% Cr, 4% W, 0.9% C; 16% Co, 10% Cr, 1–⅔% Mo, 1.1% C; and 6% W, ½% Cr, ¾% C steels was studied, from 0° C. to 150–200° C. The 6% W steel lost its coercive force much more rapidly than the others at temperatures above 120° C. The curves for the 36% and the 16% Co steels are nearly parallel, the latter showing the lower percentage loss. The aging phenomenon is ascribed to a colloidal structure in the steel. HWG(10f)

On the Age-Hardening Mechanism in Al-Mg_2Si Alloys and in Duralumin. S. KOKUBO. *Kinzoku no Kenkyu*, June 1931, pages 289–310 (in Japanese); *Science Reports, Tohoku Imperial University*, Vol. 20, No. 2, pages 268–298 (in English).

Age-hardening mechanism in quenched Al-Mg_2Si alloys was investigated by measuring the changes in density, in electric resistance and in hardness caused by various modes of heat-treatment. The dilatation and thermal curves for the quenched specimens were also measured. The observed facts did not agree with the conclusions based on the precipitation theory of Merica and others as in the case of Al-Cu alloys, and the author has proposed a new theory, the solid solution theory, as in the case of Al-Cu alloys and it was found to fit very satisfactorily with the observed facts. According to the solid solution theory, the magnesium and silicon which are dissolved in dispersed state atomically in the space lattice of aluminum precipitate in three steps, that is, (a) magnesium and silicon atoms move within the lattice of aluminum and concentrate themselves to a configuration suitable for the formation of the compound; (b) a group of these atoms is precipitated as the compound; (c) then these molecules or molecular groups coagulate themselves and build up a space-lattice characteristic of the compound. These processes may take place in close succession or partially overlapped. By the process (a) above mentioned, the distorsion of aluminum lattice is greatly increased in age-hardening at room temperature to 150° C. This causes the increase in electric resistance, a decrease in density and an absorption of heat; and these facts are the objections to the precipitation theory. In tempering at 150° to 250° C., the two processes (a) and (b) take place briskly and hence the density greatly increases, the electric resistance diminishes markedly and a great heat evolution takes place. The tempering in the range 250° to 450° C. causes process (c) to take place. The recrystallization of the matrix will also take place, by which the surface and strain energies are transformed into heat and hence a heat evolution is observed. The mechanism of age-hardening in duralumin was clearly explained as the combined effects of the age-hardening of Cu-Al alloy and of Al-Mg_2Si alloy. KT(10f)

Malleableizing (10g)

Malleable Castings, from the Practice—for the Practice. (Der Temperguss; aus der Praxis—für die Praxis.) PAUL VIDOR. *Giesserei-Zeitung und Giesserei*, Vol. 18, Jan. 2, 1931, pages 8–14.

Possible applications for malleable iron, its composition, the importance of C, Si, Mn, P, S and their mutual action are discussed in detail. The actual process during malleableizing isexplained. The equipment for a foundry, molding and molds, melting and pouring is described and illustrated. The calculation of the composition of the raw material for a given end product is discussed and explained by curves. Ha(10g)

High Quality Malleable Casting. (Ueber hochwertigen Temperguss.) E. PIWOWARSKY. *Giesserei-Zeitung und Giesserei*, Vol. 18, Jan. 2, 1931, pages 19–24.

The quality of modern malleable iron has been considerably improved by competition with steel castings. Its properties are between those of cast iron and steel, but it has been more expensive than steel. The conditions for producing black iron may be simpler than those necessary for white iron. It shrinks less and has a higher elongation than white iron and is, therefore, more economical. The methods of production, the influence of wall thickness and content of Mn and the possibilities of refining are explained and treated in detail and illustrated by Diagrams. Micrographs show the influence of different annealing temperatures on carbonization. The addition of Ni and Cr greatly improves the mechanical properties. For details, the reader must refer to the paper and to the 26 references which supplement the article. (10g)

Malleable Iron by Short Anneal. C. B. PHILLIPS (Surface Combustion Co.). *Metal Progress*, Vol. 19, Mar. 1931, pages 99–102.

Practice developed at Southern Malleable Iron Co., East St. Louis, Illinois in reducing the time of annealing for malleableizing is described and discussed. WLC(10g)

The Theory of Malleableizing of Cast Iron according to American Methods. (Die Theorie des Temperns von Gusseisen nach amerikansichen Verfahren.) N. HEKKER. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Jan. 2, 1931, pages 14–19; Jan. 9, 1931, pages 39–45.

When cast iron is malleableized in an annealing process, the disintegration of iron carbide Fe_3C in $3Fe + C$ is initiated. The material is kept at this temperature and then slowly cooled so that this reaction can be fully completed. The manner of calculation of the amount of solid solution and several analyses are cited. The most favorable conditions for tempering are described; failures are investigated and their causes are explained. Examples of calculation of a material of definite qualities illustrate the conclusions. Ha(10g)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

The Viewpoints for the Training of Welding Personnel with Particular Reference to the Welding Engineer. (Die Gesichtspunkte für die Ausbildung des Schweisspersonals unter besonderer Berücksichtigung des Schweissingenieurs.) W. PROX. *Autogene Metallbearbeitung*, Vol. 23, Sept. 15, 1930, pages 283–286.

A paper discussing the education of welders from the standpoint of the designing, operating and erecting engineer, theoretical as well as practical. Ha(11c)

Some Problems of Resistance Welding. C. L. PFEIFFER. *Journal American Welding Society*, Vol. 10, Apr. 1931, pages 5–11; *Welding*, Vol. 2, June 1931, pages 377–383.

Some fundamental concepts of resistance welding are discussed for the purpose of determining their applicability to specific problems in the design and manufacture of apparatus assemblies and machinery. The factors to be considered in resistance welding are current density per unit area, time of current cycle, pressure per unit area, electrical conductivity of the parts being welded, heat conductivity of the parts, specific heat of the parts, melting points of the materials, medium in which the joint is to be made, cooling stresses, heat fusion, contact resistance. The proper design of welded apparatus assemblies should take into account the type of joint, choice of material, shape at the point of welding and accessibility of electrodes. The materials most universally used for welding are, in order of their weldability, wrought iron, low carbon steels, nickel, nickel silvers, monel bronze, galvanized iron, permalloy, high carbon, silicon, cobalt or chromium steels, duralumin, nichrome or chromel, aluminum, copper, brass, zinc, lead. The advantage of automatic welding is discussed and a few special cases, such as welding of small pieces of rare metals to other materials, are treated more fully. Ha(11c)

Development and Present State of Rail Welding. (Entwicklung und gegenwärtiger Stand der Schienenschweissung.) M. REITER. *Organ für die Fortschritte des Eisenbahnwesens*, Vol. 85, Sept. 15, 1930, pages 398–405; Oct. 1, 1930, pages 419–432.

The author gives an exhaustive outline of the development and present state of rail welding and arrives at the conclusion that a completely satisfactory solution of the problem is not attained as yet by any of the various welding methods. The subsequent heat-treatment results in an improvement of the grain size, but not in an essential gain in physical properties. A large part of the paper is devoted to the utilization of the following testing methods for the investigation of the seam: tensile strength, cold bending test, impact bending test, impact test with notched samples, impact endurance tests and Brinell hardness test. The paper includes 46 illustrations which refer to welding equipment, various welding methods, microstructure of welded seams, macro-photographs etc. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 82. EF(11c)

Manufacture of Welding Wire. GEORGE S. ROSE. *Iron & Steel Engineer*, Vol. 8, May 1931, pages 227–229.

Paper read before the Pittsburgh Section Jan. 21, 1931. The author discusses the manufacture of welding rod, the care necessary and the testing required to produce the best product. Tests for the users are urged in order to obtain proper selection for the job. WLC(11c)

Ramblings in the Field of Welding Technique. (Schweisstechnische Streifzüge.) HANS A. HORN. *Die Schmelzschweissung*, Vol. 9, Apr. 1931, pages 75–78; June 1931, pages 135–137.

This is a report of experience in the welding of new metals and alloys gained in the experimental and training shops for welding technique in Berlin. The tests made on them are outlined. Reports are made on welding and soldering of aluminum alloys (pipes, tanks, safety belts), fluxes, light metals and refining. A tabulation of physical and mechanical properties of normal and refined aluminum alloys, manganese alloys and cast alloys is added. The tests have shown, throughout, that a heat treatment of welds of refined aluminum alloys is inadvisable because invariably the weld and the neighboring annealed places show not more than 65% (usually less) of the normal tensile strength; the elongation is still less. Castings, however, showed a better result than the original material. Another chapter discusses the properties of beryllium to increase the strength of Cu and Al-bronzes and the extraordinary increase of electrical conductivity of more than 100%. A good flux for the welding of electron metal is given as:

potassium chloride	45%
sodium chloride	30%
lithium chloride	15%
potassium bisulphate	3%
potassium fluoride	7%

The question of soldering and welding of electron castings is also discussed. A really reliable, permanently stable method has not yet been found. Ha(11c)

The Behavior of High-Carbon and Alloyed Electrodes for Wear-Proof Built-Up Welds in Welding with the Electric Arc. (Das Verhalten kohlenstoffreicher bezw. legierter Elektroden für verschleissfeste Auftragsschweissungen bein Verschweissen mit dem elektrischen Lichtbogen.) KARL TEWES. Doctor's Thesis. *Die Schmelzschweissung*, Vol. 9, Apr. 1931, pages 79–82; June 1931, pages 138–142.

This very comprehensive investigation of the chemical-physical properties of electrodes extends to the following subjects: (1) the melting times were determined for different polarities; (2) under the same conditions, the quality of molten metal (in g./sec.) was also determined; (3) the burnt-away part of the electrodes, that is the difference in percent of the component parts of the alloy before and after welding, has been determined at different polarity by chemical analysis; (4) the burning depths, that is, the degree of melting-together of electrode material with the parent material, was determined; (5) the hardness of the beads was determined for different polarities and currents. The arrangement and equipment of tests and analysis of materials is described. The test results are reproduced by curves, tables and micrographs. It can be concluded that the resistance to wear is determined not only for the hardness, tensile strength and toughness of a material but can be influenced also by some unknown interior properties, such as change of interior resistance due to change of structure. Ha(11c)

Removing Rivets with Arc on the C. & O. C. W. BEBOUT. *Welding*, Vol. 1, Nov. 1930, pages 895–896.

Twenty-five steel cars can be dismantled in a day in the car shops by using the carbon arc cutting process. One operator burns form 800 to 1200 rivets per 8 hr. day. Shop facilities, equipment and procedure are described. The average cost of removing 1000 rivets by this process amounted to $11.54. Ha(11c)

Cost of Structural Steel Welding. G. D. FISH. *Welding*, Vol. 1, Dec. 1930, pages 986–989.

Explains the manner of making up cost sheets, covering cost of steel, shop fabrication, shop and field welding, erection, painting, drawings and inspection. A few sample cost sheets are made up. Ha(11c)

High and Low Pressure Welded Pipe Lines. E. R. BENEDICT. *Welding*, Vol. 1, Nov. 1930, pages 913–914.

Description of a tunnel designed for the use of welded structural steels and a large completely welded steam separator. Ha(11c)

A Simple Practicing and Testing Device for Gas Welders. (Eine einfache Uebungs- und Prüfvorrichtung für Gasschmelzschweisser.) WILH. GELDBACH. *Die Schmelzschweissung*, Vol. 9, Sept. 1930, page 216.
Describes a device for a beginner to practice using in holding burner, electrode, adjusting flame, etc., in order to save material. Ha(11c)

German Engineers Study Welded Joints. Correspondence from E. W. EHN, Cannstatt, Germany. *Metal Progress*, Vol. 19, Mar. 1931, pages 90–91.
The writer reports studies of Germans on welding technique and testing. WLC(11c)

Welding of Stainless Steel. J. W. HOSTETTLER. *Journal American Welding Society*, Vol. 9, Dec. 1930, pages 48–60.
Includes discussion. See "Welding of Rustless Steels is Making Progress," *Metals & Alloys*, Vol. 2, April 1931, page 83. (11c)

Repair Work on the Tray of a 15,000 m³ Filled Gas Storage Tank by Electric Welding. (Reparateur der Tasse eines gasgefüllten Gasbehälters von 15,000 m³ Inhalts mittels elektrischer Schweissung.) D. T. METZDORF. *Das Gas- und Wasserfach*, Vol. 74, Jan. 1, 1931, pages 9–12.
The cheap method of repair by electrical welding is discussed, schematically illustrated and the various stages during the repair work shown in 13 illustrations. EF(11c)

Experiments with Cast Iron Cold Welding. (Untersuchungen über Gusseisen-Kaltschweissung.) H. BUCHHOLZ. *Die Schmelzschweissung*, Vol. 9, Aug. 1930, pages 183–187.
In order to check certain results, published in the literature, obtained with specially covered electrodes, a series of tests was made. When cold welding cast iron, the formation of cracks, nitrides and gas bubbles and the bindability have especially to be watched. They are discussed and the importance of Al, Mg and Si as additions to the coating of the electrodes is pointed out. The results obtained differed greatly from previously published results. In order to explain the differences, the temperature range of the iron, within which it is possible for an absorption of C to take place, was determined. As maximum, a content of 2.7% C could be obtained in the seam. The character of the seams for the different electrodes used is shown in microphotographs. Ha(11c)

Instruction and Training in Welding Technique. (Der Unterricht und die Ausbildung in der Schweisstechnik.) E. KALISCH. *Die Schmelzschweissung*, Vol. 9, July 1930, pages 166–167.
Discusses a series of welds a student should do and some books for his use which have proved useful. Ha(11c)

Welding Applied to Maintenance Work. E. H. PACY. *Welding*, Vol. 1, Jan. 1930, pages 171–173.
Describes a few examples of structures having been strengthened by welding and tests made during progress of the work. Ha(11c)

Additional Welding-On of Rolled-On Flanges. (Zusätzliches Verschweissen von aufgewalzten Flanschen.) H. HOLLER. *Autogene Metallbearbeitung*, Vol. 23, Apr. 1, 1930, pages 99–104.
Tests have shown that additional welding of flanges which are rolled or screwed on can be successfully applied to strengthen and tighten the joint. Ha(11c)

The Training Shops for Welding Technique in Berlin. (Die Berliner Lehrwerkstätten für Schweisstechnik.) HANS A. HORN. *Die Schmelzschweissung*, Vol. 9, July 1930, pages 149–150.
Description of building and equipment donated by the city of Berlin, as well as curriculum, lectures, etc. Ha(11c)

Experiences with Acetylene-Welded Rims of Supporting Rolls. (Erfahrungen mit azetylengeschweissten Stützrollenbandagen.) H. HOLLER. *Autogene Metallbearbeitung*, Vol. 23, May 1, 1930, pages 137–139.
A few suggestions on the welding of rims of rolls which are under heavy pressure supporting rotating drums, tanks and containers in mills, crushers, etc. Ha(11c)

The Behavior of High Carbon Addition Materials for Built-Up Welding in the Electric Arc. (Das Verhalten kohlenstoffreicher Zusatzwerkstoffe für Auftragsschweissungen im Lichtbogen.) W. HOFFMANN. *Die Schmelzschweissung*, Vol. 9, Oct. 1930, pages 229–230.
The determination of melting time with different polarity is of importance only for additions with low carbon contents. Materials with more than 0.25 C can be welded only on the positive pole. The test results show that these materials have a higher seam strength than the strength of the material. On an average, it was increased from 45 kg./mm.² to 65 and 81, respectively, for 2 different materials. It was further found that, with increased current, the strength is reduced. Ha(11c)

The Welding Training Shop of the State Vocational School at Siegen. (Die Schweisslehrswerkstatt der Staatlichen Fachschule Siegen.) DIR. HENSCHER. *Autogene Metallbearbeitung*, Vol. 23, May 1, 1930, pages 139–141.
Opened 1929; 17 welding places. Description of building and equipment. Ha(11c)

The Training of the Fusion Welder. (Ueber die Ausbildung des Schmelzschweissers.) OTTO MIES. *Die Schmelzschweissung*, Vol. 9, Aug. 1930, pages 175–177; Sept. 1930, pages 202–205.
Paper read before the convention of the Association for Autogenous Welding in Halle, June 1930. The principal points covered are: the training of welding experts, including welders, foremen and engineers, can be done thoroughly only by practical experience; a welder must serve an apprenticeship; the different grades of schooling and training have been arranged in the courses of the Verband für Autogene Metallbearbeitung. At present, the most acute question is the education of engineers, both operating and designing, for whom, as yet, no definite curriculum has been formulated. Ha(11c)

The New Welding Training Shops of the State United Technical Schools in Dortmund. (Die neuen Schweisslehrwerkstätten der staatlichen vereinigten Maschinenbauschulen in Dortmund.) MUELLER. *Die Schmelzschweissung*, Vol. 9, Oct. 1930, pages 223–224.
Description of buildings and equipment. Ha(11c)

Shrinking Stresses in Welding. (Ueber Schrumpfspannungen beim Schweissen.) H. W. NIES. *Die Schmelzschweissung*, Vol. 4, Apr. 1930, pages 85–87.
Takes issue with the paper of Mies, Nov. 1929, about certain assumptions to explain the cause of shrinking stresses. The actual occurring of fractures of welded seams point to exactly the opposite of the conclusions arrived at by Mies, namely that the greatest danger of breaking exists when welding small strips together and that with wider strips this danger decreases; the very opposite is the case. The author develops, therefore, formulas which cover actual conditions much better; this is largely due to the fact that the expansion by heating of the parts to be welded is taken into account which, in the other paper, had been neglected. Ha(11c)

The New Regulations for Rating and Testing of Direct-Current Arc-Welding Machines RESM/1931. (Die neuen Regeln für die Bewertung und Prüfung von Gleichstrom-Lichtbogen-Schweissmachinen RESM/1931.) LOTTMANN. *Die Schmelzschweissung*, Vol. 9, June 1930, pages 132–134.
The new German regulations proposed by the VDI are reprinted in full with comments and explanations. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 10. Ha(11c)

Gas-Welding Machines in Germany. K. P. BERTHOLD. *Welding*, Vol. 1, Oct. 1930, pages 815–819.
A comparison of the uses of gas welding in the United States and in Germany. In Germany, longitudinal seams subjected to heavy stresses are preferably gas-welded because this method gives a stronger seam than an electrically welded seam. The construction of some automatic welding machines, both for longitudinal and for circular seams, is described. Ha(11c)

Automatic Shape-Cutting for Machine Parts. R. W. BOGGS (Linde Air Products Co.). *Iron Age*, Vol. 126, Aug. 14, 1930, pages 416–417.
Increased use of oxy-acetylene shape-cutting is due to recent perfection in the machine which increases accuracy in cutting. When many identical pieces are to be cut, templets are used to direct the cutting flame. Cuts are so smooth and accurate that for many purposes further machining is unnecessary. Most important uses of automatic shape-cutting machines are for fabricating machine bases and frames. If steel having a C content higher than 0.25%, or a definite content of alloy, is to be cut it should be preheated before cutting and afterwards normalized. VSP(11c)

Uses of Steel Castings as Affected by Welding. R. A. BULL (Director Electric Founders' Research Group). *Metal Progress*, Vol. 19, Feb. 1931, pages 70–76, 154.
The author states erroneous impressions are abroad regarding the extent to which steel castings are being replaced by welded structures or have been replaced by forgings in high pressure pipe lines. Quality of steel castings, their applications, and joining of small castings of good quality by welding are discussed. WLC(11c)

Designing for Rapid Production of Spiral Welded Pipe. LEON CAMMEN. *Machine Design*, Vol. 3, April 1931, pages 45–47.
Description of a machine which does the following: prepares the skelp, coiling it into desired shape, joins the seam, welds the seam, and cuts off the pipe. The single steps are discussed at length. Ha(11c)

Fabrication by Arc Welding. A. M. CANDY (Westinghouse Electric & Mfg. Co.). *Electric Journal*, Vol. 28, June 1931, pages 345–349.
An abstract of a paper read before the American Society for Testing Materials, Mar. 18, 1931. To obtain the maximum benefit from arc welding, the structure must be designed specifically for this process. Several examples are discussed to show the open-minded approach to this process by construction men. Twelve advantages of arc welding in fabrication are listed. WHB(11c)

A Neutralized Welding Generator. F. CREEDY. *Electrical Engineering*, Vol. 50, June 1931, pages 412–414.
By reducing the magnetic energy stored in the generator field, transient currents in d. c. welding machines can be largely eliminated. Providing such generators with neutralizing windings reduces this energy to a minimum. The stability of all welding apparatus is defined in terms of what may be called the "stability ratio" and this is defined and measured by: (1) applying full load to the welder by means of a resistance; (2) by arranging a switch so that the resistance may be short circuited instantly, short-circuiting the terminals of the machine through the steadying reactance, and (3) by measuring the maximum current kick produced when the short-circuiting switch is closed. The stability ratio is the ratio of this maximum kick to the normal full-load current. Results of a thoroughly mathematical study of problems involved are briefly summarized. WHB(11c)

The Examination of Welders by Means of Tests of Sample Welds. (Die Prüfung der Schweisser an Hand der Untersuchungen von Probeschweissungen.) ECKERMAN. *Die Schmelzschweissung*, Vol. 9, July 1930, pages 151–157.
The qualification of an electric welder can, in the opinion of the author, be judged properly only by thorough tests of the welds he makes. He has developed a welding examination where the welder has to weld boiler plates of 12 mm. thickness in different positions with a given electrode. The welds are tested for bending angle, tensile strength, elongation. Details of methods of welding and test forms are described. Ha(11c)

Electric Stitching or Lap Spot-Welding. (Die elektrische Stepp- oder Laschen-Punktschweissung.) A. DAMBEK. *Die Schmelzschweissung*, Vol. 9, July 1930, pages 168–169.
Simple electrical spot welding has the disadvantage of requiring overlapping if the joint is to have sufficient strength. A new method is described: the "stitch spot-weld." The parts to be joined are, as in butt welding, laid against each other without space between and a flap over them on the underside. Then spots of metal are melted on, overlapping each other so that the seam has the appearance of a stitched piece. A machine for this kind of welding for almost any type or size of work piece is described. The upper electrode is moved up and down about 250 times/min.; the diameter of the spot is about 3 to 4 mm. for a sheet of 1 mm. and a flap of 0.5 mm. The overlapping of the points is about 0.6 to 1 mm. Ha(11c)

Electrical Arc Welding as Capillary Phenomenon. (Die elektrische Lichtbogenschweissung als Kapillarvorgang.) P. FLAMM. *Die Schmelzschweissung*, Vol. 9, May 1930, pages 105–110; July 1930, pages 162–165.
Experiments with slow-motion moving pictures have corroborated the view, expressed earlier by this author, that in arc welding the electrode melts in drops. Each drop grows in the electric arc to a size which is given by the physical laws of capillary action. If this size is exceeded, the weight of the drop is sufficient to separate the drop from the end of the electrode by gravity and, immediately, a new drop is being formed. The velocity of forming drops is mainly dependent on the current density; with increasing density, the number of drops increases. The conditions are fully discussed with reference (1) to the support the drops find on the electrode and to the shape of the drops from the time of their inception until their junction with the work material, that is, while forming a bridge from the electrode to the work piece; (2) how the capillary tension determines the size of drops and the welds. Analogous conditions can be created by dipping an iron rod into oil and slowly extracting the rod, a bridge similar to the iron drop is then formed by the oil drop between rod and oil surface. This method has been used for measuring exactly size and diameter of bridge. The films then showed the different shapes of the bridge. Ha(11c)

The Development of the German Large Butt-Welding Machine. (Der Werdegang der deutschen Gross-Stumpfschmelzmaschine.) A. DAMBEK. *Die Schmelzschweissung*, Vol. 9, Sept. 1930, pages 210–213.
This machine was developed especially for butt welding or melting together very thin sections such as those of 1000 mm. length by 0.8 to 1.0 mm. thickness, as in the case of the manufacture of automobile bodies. The principal characteristics of this machine are (1) relatively low energy consumption because the actual welding time is very short (1000 × 1 mm. about 5 to 7 sec.); (2) very small heating zone, therefore no warping; (3) if properly welded, sufficient strength (97 to 100%) and perfect tightness; (4) very small change of grain in the weld; (5) very little machining after welding to obtain good appearance. The latest type can make 40 to 60 welds in one hr. of maximum 1300 mm. length by 1 mm. thickness; for smaller objects, 80 to 120 butt welds can be made. The mechanical construction with the electrical part is fully described. Ha(11c)

Welded Pipe Joints in Steel Architecture. (Geschweisste Rohrverbindungen im Stahlhochbau.) R. ULBRICHT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, June 13, 1931, pages 759–760.
A few illustrations of correct and incorrect joints of pipe construction with and without gusset plates at the joints. Ha(11c)

Welding of Corrosion Resisting Steels. Part II. WM. SPRARAGEN. *Welding*, Vol. 1, Dec. 1930, pages 979–980.
General instructions are given for the technique used in welding these steels by the various processes. They can all be satisfactorily welded although in some subsequent annealing is necessary. Ha(11c)

Analysis of Steel for Welding. W. E. STINE. *Metal Progress*, Vol. 20, Aug. 1931, pages 91–94.
Effects of aluminum as alloy and oxide, of manganese and silicon on the character of weld produced are discussed. Use of a fully shielded arc and an "autogenizer" are described and discussed. WLC(11c)

Pipe Welding, How, When and Where to Do It. WM. SPRARAGEN. *Welding*, Vol. 2, July 1931, pages 450–454.
The third installment deals with refrigerating piping, welded building and residence piping, thermit and resistance welding of pipe, welding of cast iron pipe, automatic carbon arc-welding. The respective procedures are briefly described. Ha(11c)

Commercial Production of Welded Steel Machinery Parts. G. D. SPACKMAN. *Iron Age*, Vol. 126, July 31, 1930, pages 290–291, 314.
Capital outlay for welded steel fabrication is large and manufacturer is justified in gaining experience before making heavy expenditures for equipment and alterations. Production of welded structures involves 3 important requirements: (1) use of welding quality steel; (2) weld metal having physical properties at least as good as original unwelded steel; and (3) rigid procedure control of welding operations. Material handling is of importance so far as production rate is concerned. There are wide applications for utilizing plate steel but welded steel construction cannot replace all castings. VSP(11c)

Possibilities of Repairing Aluminum Pieces by Soldering and Welding. (Ausbesserungsmöglichkeiten von Aluminiumwerkstücken durch Löten und Schweissen.) H. REININGER. *Die Schmelzschweissung*, Vol. 10, May 1931, pages 117–120.
Continued from the April issue. In this installment, the kinds of parts and defects which can be mended by soldering or welding and the production and properties of the soldered and welded joints are discussed and illustrated by means of photographs and sketches. Ha(11c)

Hydraulic Turbine Repaired by Electric Welding. C. R. REID. *Power*, Vol. 73, Mar. 24, 1931, pages 478–479.
A vertical-shaft Francis-type cast-iron runner 12 ft. in diameter and weighing 70,000 lbs. failed. The unit was rated at 20,000 h.p. at 120 r.p.m. under an 80 ft. head. Apparently one of the runner buckets had been cracked through at the upper end near the hub for some time. Other runner buckets were cracked. The broken ones were replaced with cast steel and the cracked ones repaired, all by electric welding. The unit is operating satisfactorily. VVK(11c)

Shield Welded Pressure Vessels Now Safe for All Hazardous Uses. G. RAYMOND. *Petroleum Engineering*, Vol. 2, Midyear, 1931, pages 147–148, 150.
Discussion of the shielded welding process which forms joints of nearly 100% efficiency between parts of almost any thickness or shape. (11c)

Welding of an Aluminum Crankshaft Case of a Bus. (Schweissung eines Aluminium-Gehäuses eines Omnibusses.) W. K. RAABE. *Die Schmelzschweissung*, Vol. 10, May 1931, page 126.
Describes the repairing of a crack of 25 cm. length due to the continuous vibrations. The case was preheated to 100° C. Ha(11c)

The Design of Welded Steel Structures. Part VI. H. A. MCCREADIE. *The Welder*, Vol. 2, Apr. 1931, pages 2–4.
This installment deals with the general construction of plate girders. The distribution of stresses is discussed in general. Ha(11c)

Shrinking Stresses in Welded Seams. (Schrumpfspannungen in Schweissnähten.) K. MELCHER. *Die Schmelzschweissung*, Vol. 10, May 1931, pages 128–129.
Shrinking stresses are produced in the following manner: After welding, the melt entirely fills the space between the parts to be joined. Solidifying, the weld shrinks and tries to approach the two parts. If these are kept rigidly in place, the melt must keep the same width in spite of its tendency to shrink and tensile stresses are the result. Such shrinking stresses are greater in butt-welded seams than in fillets. Several cases of shrinking conditions are discussed. The influence of size, weight and manner of support of the piece to be welded are explained. A basis is given on which to decide whether the pieces must be clamped rigidly or remain freely movable to avoid stresses in the finished state. Ha(11c)

Welding with Atomic Hydrogen Process. Part II. SAM MARTIN. *Welding*, Vol. 1, Dec. 1930, pages 990–991.
A brief description with illustrations of the proper methods of welding steel castings, alloy steels and other metals and the repair of dies. The consumption of hydrogen depends on the size of the equipment and the current used; it varies between 35 and 50 ft.^{3}/hr. at a pressure of from 1 to 2 lb./in.^{2}. Care must be taken that no leaks occur because a mixture of air and hydrogen is highly explosive at from 9.5 to 74% hydrogen by volume. Directions for the storing of hydrogen are given. Ha(11c)

Progress in Arc Welded Construction of Oil Pipe Lines. J. F. LINCOLN. *Oil Weekly*, Vol. 61, May 8, 1931, pages 67–68, 76.
Advantages of this method are increased ductility and resistance to corrosion in the welded joints, greater construction speed, reduced maintenance and repairs, increased life and more economy. (11c)

Welding Essential in the Coal Industry. C. B. LEBON. *Welding*, Vol. 1, Dec. 1930, pages 971–974.
The Pittsburgh Coal Co. saves much time and money in repairs of the mining equipment of their 19 mines by welding. Ha(11c)

The Progress of Arc Welding. German and American Practice in the Shipyards. E. D. LACY. *Metallurgia*, Vol. 4, July 1931, pages 89–90.
Welding in ship construction has proved very satisfactory both in Germany and in the U. S. Welded seams do not corrode any faster than other parts of the plates. Welding allows the weight to be decreased. Welded German vessels can carry larger guns than riveted vessels because the firing of the guns would shear the rivets, while it does not damage the welded construction. JLG(11c)

Testing of Welding Burners for Low-Pressure Acetylene. (Das Prüfen von Schweissbrennern für Niederdruckazetylen.) W. KNOCH. *Autogene Metallbearbeitung*, Vol. 24, June 15, 1931, pages 179–183.
The requirements of a welding burner are discussed with regard to economy and safety; especially the safety against backfiring must be absolute. Several constructions are described and tests on 4 burners are reproduced. Ha(11c)

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Bronze Welding of Steel and Cast Iron. THOS. D. KETCHBAW. *Welding*, Vol. 1, Dec. 1930, pages 981–985.

In this practice, no fusion between weld and parent metal takes place but it is an adhesion somewhat resembling soldering in principle. The surface pores of the metal become enlarged by the increased temperature and allow the molten bronze to be drawn into the pores by capillary action. When cold again, the contracted parent metal holds the bronze. A detailed description of the preparation of the pieces to be welded and the procedure refers especially to locomotive frames and cylinders. Illustrations of the welded pieces are included. Ha(11c)

Cost of Using Welding. ROBERT E. KINKEAD. *Metal Stampings*, Vol. 4, Jan. 1931, page 28.

Paper presented at the fall meeting of the American Welding Society. See *Metals & Alloys*, Vol. 2, Jan. 1931. JN(11c)

The Spot Welding of Stainless Steel. JOHN F. HARDECKER. *Airway Age*, Vol. 13, July 1931, pages 36–39.

Describes the general trend of spot welding in aeronautical design, particularly with the "18 and 8" chromium and nickel stainless steel. Experiments carried out at the Edward G. Budd Company, Philadelphia, indicate encouraging results of spot welded members. A wing rib loaded to half of its ultimate factor, and this load released and reapplied 80 times a minute, at the same time a vibration of 1800 periods a minute is produced to simulate a rough engine, showed, after 1,400,000 cycles, no signs of weld or material failure. Much remains to be done, but spot welded stainless steel construction has had a truer introduction to aeronautical utilization than has any other new material. It appears to be one of the few instances where a new material has been investigated scientifically where no immediate interest in the marketing of the material is involved. WAT(11c)

Training Arc Welding Operators. A. F. DAVIS. *Electrical Manufacturing*, Vol. 8, July 1931, pages 29–30.

A student welding operator should be instructed primarily in the control of the welding current and be given the opportunity to spend much time in practice. He should be taught that arcs are injurious to the skin and eyes and require constant protection for these parts. He should first master welds on flat pieces, then advance to vertical welding. WAT(11c)

Electrical Resistance Welding. M. L. ECKMAN. *Western Machinery World*, Vol. 22, Aug. 1931, pages 357–361.

Each type of welding is described in detail. Mechanically operated flash welding, butt welding, spot and projected welding, seam welding and resistance welding are described. A table is given presenting spot welding data showing K. W. and H. P. required to weld sheet material from .0125 to .25 inches in thickness. WAT(11c)

Copper Alloy Welding Rods. I. T. HOOK. *Iron & Steel Engineer*, Vol. 8, July 1931, pages 337–341.

List of nineteen welding rod materials shows their melting points, thermal conductivity, coefficient of linear expansion and average strength of welds. Objectionable materials are briefly discussed. Seventeen welding properties are enumerated and discussed in connection with the materials listed. Applications are briefly discussed. WLC(11c)

Welding. C. A. ADAMS and others. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Published 1931, Vol. 36, *Mining and Metallurgy*, Part 4, pages 247–332. 95 figures.

A brief résumé comprising short comments as follows: Foreword, C. A. Adams; Procedure Control in Welding, H. H. Moss; Welding Wire, C. A. McCune; Welding Apparatus, E. H. Ewertz; Structural Steel Welding, F. P. McKibben; Arc Welding as a Factor in Construction Economy, G. D. Fish; Replacement of Castings by Welded Steel, J. F. Lincoln; Developments in the Welding of Pressure Vessels, C. W. Obert; Welding of All-Steel Automobile Bodies, J. W. Meadowcroft; Welding as Applied in Automotive Production Methods, by M. L. Eckman; Welded Steel Pipe, A. Hazen; Making High Pressure Pipe by Arc Welding, T. M. Jasper; Welding in Track Construction and Maintenance, E. M. T. Ryder; Welding in the Overhead Line Department, W. J. Quinn; Welding in Car Maintenance, J. S. McWhirter; Welding on Railroad Equipment, G. H. Giertsen; Shipbuilding, J. W. Owens. There are only 40 pages of text for these 17 articles, and 44 pages of illustrations. HWG(11c)

Arc Welding in Machinery Manufacturing. A. F. DAVIS. *Tech. Engineering News*, Vol. 12, 1931, pages 115, 147.

A late development in arc welding has been the introduction of the shielded arc. This new process produces welds on mild rolled steel with a tensile strength of 60,000 to 75,000 lbs./in.^{2} that are extremely ductile and highly resistant to corrosion. The principle of the shielded arc consists in preventing the oxygen and nitrogen in the ambient atmosphere from combining with the weld metal while in the molten state. Molten weld metal has a great affinity for oxygen and nitrogen, and when welding is carried out under conditions where these gases are readily available, oxidation and nitrification proceed at a high rate. These oxides in the weld impair its strength, ductility and resistance to corrosion. If the molten weld metal is protected from the atmosphere during the process of deposition, the weld so produced will be free of oxides and nitrides. WAT(11c)

World's Tallest Welded Building. ORVILLE ADAMS. *Welding*, Vol. 1, Nov. 1930, pages 903–906.

Describes some unusual methods used in the erection of the 19 story all-welded office building of the Dallas Power & Light Co. Some details are illustrated and the method of erection is discussed briefly. Ha(11c)

Welding Practice on Heavy Engines. ORVILLE ADAMS. *Welding*, Vol. 1, Aug. 1930, pages 674–677.

Discusses preheating, welding and calculation of costs for repairs to pistons, cylinder heads and cylinders of gas and Diesel engines. Ha(11c)

Comparative Examination of Progressing and Retrogressing Welding. (Vergleichende Untersuchung der Vorwärts- und Rückwärtsschweissung.) BARDTKE & MATTING. *Autogene Metallbearbeitung*, Vol. 24, June 1, 1931, pages 159–164; June 15, 1931, 175–178.

Comparative tests with left and right welding or, as it is better expressed according to the different hold on the welding torch, progressive and retrogressive welding, permit the conclusion that retrogressive welding is of considerable advantage for sheets of from 6 to 16 mm., both as regards quality and economy. For about 5 mm. thickness, both processes are equivalent. If progressive welding cannot be avoided, hammering in red hot state should be employed to improve the quality of the weld. The tests are described in detail and the economy calculations given. Ha(11)c

Repair of a Cylinder Block of a Truck by Welding. (Reparaturschweissung des Zylinderblocks eines Lastkraftwagens.) W. K. RAABE. *Autogene Metallbearbeitung*, Vol. 24, May 15, 1931, pages 147–148.

A crack in the cast iron of 20 cm. length opening into 2 of the cylinders was repaired by gas welding. The procedure is explained in detail. Ha(11c)

Arc Welding in the Locomotive Boiler Shop. I. JAS. M. VOSSLER. *Modern Machine Shop*, Vol. 4, July 1931, pages 11–14.

This installment deals with the preparation of boiler seams for welding and the various methods used in welding fire box seams. It is of great importance that the welder should have had experience as a boiler maker. Proper observation of heat condition to avoid contraction strains and waste of electrical energy is essential. Cross-sections of fire box welds illustrate the article. Ha(11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Melting and Heat Treating Sterling Silver. (Schmelz- und Wärmebehandling des Sterling-Silbers.) EDMUND THEWS. *Deutsche Goldschmiede-Zeitung*, Vol. 34, May 9, 1931, pages 196–198.

Copper in Ag increases the hardness and wear resistance, but introduced difficulties in melting and rolling. The alloy should be prepared by adding granulated Cu to a crucible and covering with Ag. The mass should be rapidly melted and heated to a temperature of 1200 or 1250° C. The melt is frequently covered with charcoal, which is replaced by potash some time before casting. Before casting the melt should be deoxidized with a small amount of Cd. Annealing is best carried out in an atmosphere of N_2 or CO_2. Contains 6 references. JLG(12a)

Slag Control Essential. FOLKE W. SUNDBLAD. *Iron Age*, Vol. 126, July 31, 1930, pages 289, 314–315.

Quality of metal is directly dependent on condition of the slag. Heat worked with thin slag at high temperature without addition of lime in final stage, product will be more satisfactory chemically than physically. Through the color, structure and density of solidified slag a true story is told of what can be expected of the heat both chemically and physically. The bigger the bath area the greater the necessity of having pure slag. Steel should be purified while in furnace rather than in ladles and molds. VSP(12a)

Mixed Gases in Oven-Hearth Furnaces. GEO. E. ROSE & F. M. WASHBURN. *Blast Furnace & Steel Plant*, Vol. 18, Sept. 1930, pages 1476–1479; Oct. 1930, pages 1621–1623; *Iron & Steel Engineer*, Vol. 7, July 1930, pages 394–400.

Paper read before the Association of Iron & Steel Electrical Engineers. MS(12a)

Steel Made without Manganese. Correspondence from ALBERT SAUVEUR, Cambridge, Mass. *Metal Progress*, Vol. 20, Aug. 1931, page 86.

Claims that zirconium is essential to produce good manganese free steel is refuted by the experience of American Rolling Mill. WLC(12a)

The Melting Process in the Cupola Furnace According to Views of Inventors. (Der Schmelzvorgang im Kupelofen nach Ansichten und Auffassungen von Facherfindern.) CARL REIN. *Giesserei-Zeitung und Giesserei*, Vol. 18, Jan. 9, 1931, pages 33–37; Jan. 16, 1931, pages 58–64; Jan. 23, 1931, pages 78–83.

A critical review of constructions, patents, advantages, etc. Ha(12a)

Relation of Manganese in Molten Iron to Manganese in the Molten Slag which Covers the Iron. G. OISHI. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 397–428.

In English. Attempts were made to determine the distribution constant with siliceous slag, "limey siliceous slag" and basic slag. Curves are given for manganese in metal and slag at different temperatures. HWG(12a)

Oxygen-CO Blast for Iron Furnace. Correspondence from E. ÖEHMAN, Stockholm, Sweden. *Metal Progress*, Vol. 19, May 1931, pages 87–88.

The writer gives an outline of a method of blast furnace operation designed to save charcoal. WLC(12a)

Melting Grey and Malleable Iron in the Indirect-Arc Furnace. J. C. BENNETT & J. H. VOGEL. *Foundry Trade Journal*, Vol. 44, June 4, 1931, page 371.

Paper read before the Chicago convention of the American Foundrymen's Association. See *Metals & Alloys*, Vol. 2, July 1931, page 135. OWE(12a)

Crucible Tool Steel Melting. OWEN K. PARMITER. *Metal Progress*, Vol. 20, July 1931, pages 55–58.

Recommended Practice Committee Release. The charge, melting and deoxidizing methods are recommended. WLC(12a)

How Swedish Iron Is Made. J. A. LEFFLER. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published, 1931, *Mining & Metallurgy*, Part 1, pages 79–97.

Emphasis is placed on the purity of Swedish ore and fuel and on the care taken to avoid the presence of oxide in all Swedish iron and steel products. Composition of ores and fuel is given. The Sieurin method of making sponge iron at Hoganas is described. Blast furnaces are run at a slow rate. More iron is made in charcoal blast furnaces than in electric furnaces. The manufacture of Lancashire iron, Walloon iron and Uchatii crucible steel is described. Swedish acid Bessemer steel is a high carbon steel, not less than 0.65% C, and the carbon is caught coming down. Swedish open hearth steel is also acid, and caught coming down. Typical analyses are given for raw materials, products and slags and the various furnaces used are illustrated. HWG(12a)

Segregation in 80% Carbon Steel Ingots. E. ÖEHMAN. *Metal Progress*, Vol. 20, July 1931, page 86.

Reports electrical resistance study of segregation in .80% carbon steel. Method used for control of carbon in steel making. WLC(12a)

Refining in the Basic Open-Hearth. C. H. HERTY, JR. *Metal Progress*, Vol. 20, Aug. 1931, pages 58–63.

A paper to be presented before the Boston Convention of American Society for Steel Treating, September 1931, and to be published in greater detail with discussion in the Transactions. The author describes the basic open hearth process giving typical slag analyses and the time required for the various portions of the process. WLC(12a)

Vanadium Steel from Sponge Iron. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 20, Aug. 1931, pages 89–90.

The writer reports a double slag method of producing low phosphorus vanadium steel from sponge iron. WLC(12a)

Phase Equilibria in the Cr_2O_3–Al_2O_3 System. E. N. BUNTING. *Bureau of Standards Journal of Research*, Vol. 6, June 1931, pages 947–949.

A study of the phase equilibria in the Cr_2O_3–Al_2O_3 system has shown these oxides to be completely miscible in the liquid and solid states, with no compound formation. The melting point of Cr_2O_3 has been redetermined to be 2275° ± 25° C. Melting points of Cr_2O_3-Al_2O_3 mixtures

Mole percent Cr_2O_3	Solidus temperature ° C.	Liquidus temperature ° C.	Mole per cent Cr_2O_3	Solidus temperature ° C.	Liquidus temperature ° C.
0	2045	2045	60	2,170	.....
10	2060	2075	70	2,190	.....
20	2080	2110	80	2,205	.....
30	2100	2140	90	2,225	.....
40	2120	2170	100	2,275	2,275 ±25
50	2150	.....			

WAT(12a)

Investigation of the Steel Making Processes on the Basis of the Physico-Chemistry. (Ueber den Ausbau der Erforschung der Stahlerzeugungsverfahren auf physikalisch-chemischer Grundlage.) H. SCHENCK. *Stahl und Eisen*, Vol. 51, Feb. 12, 1931, pages 197–202.

Report 202 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The article deals with the efforts to improve quality and economy of the steel mill products and points out that the chemistry of steel making has been neglected. Some examples of the unsolved problems are given and a program of investigation is outlined. GN(12a)

The System $MgO-FeO-Fe_2O_3$ in Air at One Atmosphere. H. S. ROBERTS & H. E. MERWIN. *American Journal of Science*, Vol. 21, Feb. 1931, pages 145–157.

The system $MgO-FeO-Fe_2O_3$ has been investigated at temperatures above 1000° C. on the isobar $^1/_5$ atmosphere O_2. In the binary system $MgO-Fe_2O_3$ no compound was found other than $MgO-Fe_2O_3$ which dissociates slightly on heating and begins to melt at 1750° C. ± 25°. Solid solution extends from this compound for a short distance toward MgO. In the binary system $FeO-Fe_2O_3$ the stable phase at temperatures below 1386° ± 5° is a hematite solid solution containing less oxygen than Fe_2O_3; just above 1386° ± 5° the stable phase is a magnetite solid solution containing considerably more oxygen than Fe_3O_4. The ternary system contains two solid solution fields. The first begins at MgO below 1000° and extends with increasing temperature, toward $MgO \cdot Fe_2O_3$ and FeO; a liquid phase appears at 1770° ± 25°; where the solid contains iron oxide equivalent to 73% Fe_2O_3. The second solid solution extends, with increasing temperature, from $MgO \cdot Fe_2O_3$ toward the iron oxide boundary which it reaches at 1386° ± 5°; solid solutions of about 1% MgO in $MgO \cdot Fe_2O_3$ are possible from 1750° to 1000° C. or below. GN+WAT(12a)

Operation of an Open Hearth Furnace. Lesson 4. Reaction and Temperature. M. J. CONWAY (Lukens Steel Co.). *Iron & Steel Engineer*, Vol. 7, Aug. 1930, pages 425–428.

Author discusses the chemical reaction of the basic open hearth process giving heat records covering the elimination of carbon and phosphorus, and additions of lime, ore and deoxidizers. WLC(12a)

Duplexing. K. R. BINKS. *Iron & Steel Industry & British Foundryman*, Vol. 4, Mar. 1931, pages 194, 198.

A description of processes. CHL(12a)

Casting & Solidification (12b)

Steel Ingots. W. H. HATFIELD. *Metallurgist*, Jan. 1931, pages 8–12; Feb. 1931, pages 25–26.

This article is a review of the work of the "Heterogeneity Committee." This committee was appointed by the Iron and Steel Institute in 1924 and in 1929 was coördinated with the general industrial research scheme of the National Federation of Iron and Steel Manufacturers. It has published 3 reports in the Journal of the Iron and Steel Institute in 1926, 1928 and 1929. The First Report—1926—presents the results of a metallographic and analytical examination of a range of 16 ingots sectioned on the longitudinal axis. A section of the report was devoted to the mechanism of solidification from the theoretical point of view and a very complete bibliography was included. The Second Report dealt in a similar manner with a number of alloy steel ingots and also with tube, plate and free-cutting mild steel ingots. Ingot molds, non-metallic inclusions, temperature control and measurement, and casting conditions were discussed. The Third Report dealt largely with fundamental work which had appeared to be necessary as a result of the other investigations. Work was presented dealing with the liquidus and solidus of commercial steels executed by Andrew and Binnie at Glasgow Technical College, and on the solubility of iron and manganese sulphides in steel by the same investigators. Desch presented the results of research, conducted at Sheffield University, on the density of liquid iron and steel, while Lightfoot presented his initial report on a mathematical approach to aspects of the work which are difficult to attack experimentally. At present, the work is being continued under excellent conditions. Various types of ingots are being studied, and extensive further fundamental researches are in hand, and it is probable that a Fourth Report may be issued in the coming year. Liquid steel, when poured into the mold, is, obviously, at a temperature definitely higher than the freezing temperature. Assuming that it has cooled down to precisely the freezing temperature, it will probably be finally established that, in the change from the liquidus to the solidus phase, there is an increase in weight per unit volume of about 1.5%, i. e., a change over from an approximate specific gravity of 7.15 at the liquidus to 7.29 at the solidus. On the other hand, there is definite experimental evidence to show that, as the temperature of the liquid steel is increased, the weight per given volume becomes less; so much so that, to take a mild steel—0.2% carbon—having a freezing temperature of 1525° C. liquidus, to 1490° C. solidus ± 2° C., the following figures may be given with a fair degree of probability:

°C.	Vol. of 1 ton in cubic feet	Specific Gravity
1650	5.09	7.05
1600	5.06	7.09
1550	5.03	7.13

Moreover, as the steel continues to cool from the solidus point there is a continued increase in density probably as follows:

°C.	Vol. of 1 ton in cubic feet	Specific Gravity
1490	4.92	7.29
1450	4.90	7.31
1400	4.88	7.34
1300	4.85	7.39
1200	4.82	7.44
1100	4.78	7.49

The actual mechanism in the mold of the freezing process, the variation of temperature as it proceeds, the possibility of convection currents set up by the differential cooling, of change in viscosity of the steel, of the movement of the steel in the interstices between the partly formed crystals, and the rate of rise and fall of any suspended solid matter are still unknown and are experimentally extremely difficult to determine at a temperature range as high as 1450° to 1650° C. If one carefully studies the freezing of an ingot in the mold, one finds that very shortly after the formation of the outer frozen shell, this shell separates from the walls of the mold, and thus a space is interposed with its insulating effects—modification of radiation, conduction and convection phenomena—between the freezing ingot and the mold. How does this affect the passage of heat from the steel through the mold? What are the thermal conductivity values of the cast iron of the mold, or of the material of the ingot in these ranges of temperature? When steel freezes, latent heat is evolved; what is the effect of this? Lightfoot has made a mathematical analysis of this point. The conclusions of the Committee on solidification in the solid type of ingot are set forth. In regard to segregation the author says, "A survey of these figures indicates clearly that the C, S and P segregates to a considerable extent and together, while the Mn and Si segregate to a less degree. The detailed analyses from the sections of the numerous ingots studied by the Committee confirm this behavior of the several elements as regards different concentration in the various zones of the ingots. The differential freezing effect and the manner in which the solid steel is built up from the liquid, do not produce heterogeneity of note as regards the manganese and silicon, and this is also found to be the case with Ni, Cr and Cu. One very important feature is that the Mn and S, which are understood to exist in the final ingot as MnS, do not segregate in the proportions necessary to constitute the compound, and this leads to the deduction that when the differential freezing effect causes concentration of S, it is probably as FeS, which is soluble, and not as MnS, which is presumed to form at a late stage by reaction between the FeS and the Mn in the steel. Some of the variation in the Mn content which is noted, may be due to the fact that some of the Mn is associated with the C as a double carbide of Fe and Mn. VVK(12b)

Casting Guns by the Centrifugal Process. T. C. DICKSON (Watertown Arsenal). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 212–240.

A paper presented before the 12th Annual Convention of the Society, Chicago, September 1930; includes discussion. The author describes the machine used at Watertown Arsenal for casting gun tubes centrifugally in chill molds. Tubes properly cast show no shrinkage cavities and are slightly denser than forgings of the same composition. Strain rings show the outside is under tension, falling off to a neutral point about two-thirds the way to the bore from which point the compressive strain increases to a maximum value at the bore. This condition is not removed by heat treatment and higher pressure is necessary to cold work the bore of centrifugal castings than for forgings. Analyses taken across the section show an appreciable increase in carbon toward the bore (.32–.52% C), a slight increase in manganese toward the bore (.60–.68% Mn), a similar increase in molybdenum, fairly uniform silicon content, phosphorus and sulphur also show slight increases of .015–.022 and .022–.30%, respectively, from outside to bore but the content is well within permissible limits. Ladle analysis C .35%, Mn .61%, Si .245%, P .016%, and S .028%. The increased carbon at the bore makes for higher proportional limit where it is most needed, the pressures developed in a gun tube are greatest at the bore surface. Experience shows centrifugal castings can be worked to twice the percentage of enlargement of the bore permissible with forgings. Features of gun manufacture from forgings resulting in heavy machine costs and metal losses not entailed when centrifugal castings as used are discussed. Macrographs of centrifugal castings are shown, physical property tests, and service tests on several barrels made in this way are detailed. Metallurgical advantages of the processes are high proportional limit at the bore where needed, higher tensile and Charpy properties for the same composition, initial compression of the metal at the bore, denser, sounder metal, and ability to take more drastic cold work than forgings of the same composition. Economical advantages are the elimination of 35% ingot discard, elimination of heating for forging and heating of the forging, half as much metal required, less plant and equipment required, time of production shortened and reduction in the cost of manufacture. WLC(12b)

Standardizing Die-Casting Alloys and Machines Aids Industry. CHARLES PACK. *Steel*, Vol. 87, Nov. 6, 1930, pages 47–49; Nov. 20, 1930, pages 55–56, 59.

Discusses developments in the die-casting industry, factors to be considered in the purchase of die-casting equipment, and die-casting costs. MS(12b)

A Contribution to the Study of Fluidity. (Contribution a l'étude de la coulabilite. Applications à la fonderie de l'aluminium, de l'alpax, des alliages legers d'aluminium avec quelques essais sur le zinc.) ANDRÉ COURTY. *Revue de Métallurgie*, Vol. 28, Mar. 1931, pages 169–182; Apr. 1931, pages 194–205.

The fluidity of aluminum alloys and of zinc was studied in reference to their composition, time of pouring, pressure created in pouring, dynamic effect produced and the state of the surface. Alloys used consisted of alpax, some binary alloys with Si, Cu, Zn and Ni, a few modifications of alpax to which Cd, Mg, Ni, Cu, Zn and Mn were added. Commercial Al and Zn were tried. For testing the spiral mold in its final modifications as recommended by L. Guillet and A. Portevin was employed. (Full description given.) When it was found that for reproduction of the results pouring must be done under a constant pressure, the metal must be quiet at the point of entering the spiral proper, feeding must be conducted even when the metal is almost at the solidification point and the dross should be eliminated as much as possible, these features were incorporated into the apparatus. After standardization of the testing condition the characteristic properties of alloys were studied and the influence of the thermal treatment of molten metal investigated. Modification of alpax with sodium does not change its fluidity nor does the overheating or time held at the temperature before casting, provided the same temperature is used for the latter. The casting temperature increases the fluidity rapidly, particularly for alpax. Zinc is more sluggish in this respect. The speed of filling the spiral can be measured by short circuiting the cast metal with properly located wires. Heating of the mold between 578° and 750° C. showed that the fluidity of alpax increases according to an equilateral hyperbola in which the temperature is an ordinate. For alpax, aluminum and zinc the fluidity remains proportional to the casting pressure whatever the temperature might be. Covering the walls of the chill with liquids barely affects the fluidity while solid coatings like soot increase it. The chemical composition of aluminum alloys has a certain influence on their fluidity. In the realm of solid solutions the fluidity of Al appears to diminish with the increase of the alloying elements. Si gives them a high fluidity. Cu in Al-Cu alloys increases fluidity until its content is 8%. With low Ni and Cd contents they have the same beneficial action on alpax. Mg in amounts higher than 4% improves the fluidity of Al alloy containing 13.2% Cu. JDG(12b)

Mold Materials. (Formen-Baustoffe.) WILLI CLAUS. *Metallwirtschaft*, Vol. 10, May 8, 1931, pages 369–374.

Contains 14 references. Tables are given for the thermal properties such as melting point, specific heat in the solid and liquid state, and thermal conductivity of a large number of metals, inorganic, organic solids and liquids. Directions are given for estimating the thermal properties of alloys from the properties of their constituents and the constitutional diagrams. Molds are divided into permanent and single molds. In all cases the melting point of the mold must be higher than the pouring temperature of the metal. In choosing a mold material for a metal the necessity of producing a definite crystal structure, the elimination of porosity and the gas content of the metal should be considered. Thermal conductivity influences crystal structure. Sometimes a mold consists of two materials of different conductivities. In calculating the thermal capacity of a mold to obtain a definite cooling rate, the equilibrium temperature between mold and casting must be considered. By properly adjusting the cooling rate some metals can be made considerably denser. However, if pure aluminum is cooled too rapidly, the dissolved gases do not have a chance to escape. For alloys in which diffusion takes place during solidification low conductivity materials such as sand are best. Cu-Sn bronzes are an example of this group. Alloys which segregate due to insolubility of the components, such as Cu-Pb, require rapid cooling. Alloys in which structural changes take place during solidification are cast in the type of mold required to produce the desired structure. Although permanent molds are protected with coatings they are attacked by the liquid metal. Sand is used almost exclusively for single molds. The permeability determines the rate of gas escape and it must have sufficient strength to withstand the force of the liquid metal. CEM(12b)

The Degasification Process. J. E. HURST. *Foundry Trade Journal*, Vol. 44, Apr. 9, 1931, pages 264–265.

Describes early experiments designed to produce sound castings by promoting the removal of gases from the liquid metal and finally deals with a new process introduced at the plant of Messrs. Bradley and Foster, Limited. A photograph of the Bradley degasification apparatus accompanies the article, together with two diagrams of earlier methods of accomplishing this object. OWE(12b)

The Scientific Production of Non-Ferrous Ingots. WALTER H. JACOBSON & WILLIAM KELLY. *Metal Industry*, London, Vol. 38, May 1, 1931, pages 453–455.

The various advantages of using brass and bronze ingots made from secondary metals under close chemical control and microscopic and macroscopic examination are mentioned. A table of the chemical specifications for the 15 alloys recommended for non-ferrous ingots is given. PRK(12b)

Shrinking of Alloys. (Ueber die Schwindung von Legierungen.) FRIED. BOEHM. Doctor's Thesis published by Giesserei Verlag, Düsseldorf, 1930, 12 pages.

Tests to determine the shrinkage of a series of copper-tin alloys were made under conditions as they occur in practical foundry work, with variable cooling velocity and in various gas atmospheres. The total shrinkages can be calculated, with good approximation, with simplifying assumptions from the densities and expansion coefficients of the material. The changes of state corresponding to the diagram of state under these conditions are well expressed by the shrinkage curves. The solid solutions play an important part in the changes in shrinking. The shrinking of white raw iron has been determined for the first time. The arrangement of the tests and their results are given in detail. Ha(12b)

Die Casting Zinc and Aluminum. D. L. COLWELL(Stewart Die Casting Corp.). *Metal Progress*, Vol. 18, Nov. 1930, pages 58–63, 100.

Various researches on zinc die-casting alloys show aluminum, lead, cadmium and tin making trouble in the form of swelling, cracking, and warpage. Copper, nickel, and particularly magnesium act as antidotes for this condition. Methods of test are described and the program of A. S. T. M. on this subject and some of the data from it are discussed. WLC(12b)

Die Casting Brass and Other New Alloys. CHARLES PACK. *Metal Progress*, Vol. 20, July 1931, pages 72–78, 100.

A discussion of composition and defects in commercial die casting alloys of zinc and aluminum base with data on their properties and applications. New die casting alloys, magnesium base, cadmium base and copper base, are described and applications discussed. WLC(12b)

A Study on the Cast Iron Ingot Mold. T. NISITU. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 389–390.

In English. An iron of 3.3 to 3.8% total C, 1.5 to 2.0% Si, 1.3 to 1.8% Mn, 0.15% P and 0.07% S is suggested. Segregation of manganese sulphide is to be avoided. Casting should be rapid and the casting should self-anneal in the sand and then be transferred hot to the annealing furnace for 5 to 10 hrs. anneal at 700–800° C. In use, mold life is lengthened by proper preheating, low pouring temperature and moderate teeming rate and quick stripping. High carbon steels shorten mold life. HWG(12b)

The Effect of the Ingot Temperature on the Location of Blow Holes and the Segregation of Soft Steel Ingots. (Der Einfluss der Kokillentemperatur auf die Lage der Randblasen und auf die Seigerungsverhältnisse in weichen Flussstahlbrammen.) A. STADELER & H. J. THIELE. *Stahl und Eisen*, Vol. 51, Apr. 9, 1931, pages 449–460.

Report No. 205 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. 8 references. The results of investigations of the location of blow holes in 200 kg. and 3500 kg. ingots cast in either cold or pre-heated molds are reported. It is shown that there exists an effect of the mold temperature on the locaiton of the edge blow holes which were observed only in the heavy ingots. A favorable location of the edge blow holes, i. e., rather far from the surface of the ingot, is observed either at low ingot temperatures around 60° C. or at high temperatures above 500° C. The pouring in ingots heated to 500° C., however, is practically impossible. In small ingots no edge blow holes are observed under the normal practice. The small ferrostatic pressure is the reason for this occurrence. Streaks of segregations were discovered by metallographic investigations in both the small and big ingots. Explanations as to the origin of these streaks are given. No uniform effect of neither the cold nor pre-heated ingots upon the segregation could be detected. GN(12b)

The Casting of German Silver in Water-Cooled Chill Moulds. OTTO JUNKER. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, pages 517–518.

Adapted from an article in *Metallwirtschaft*. Results bared on continuous working experience, definitely prove the economy of casting. German silver sheet slabs in water cooled chill molds. See also "Centrifugal Casting of Metals," *Metals & Alloys*, Vol. 1, Mar. 1930, page 430. VSP(12b)

Investigation of Chilled Roll. T. KIKUTA. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 79–115. In Japanese. Brief English abstract.

Mathematical study of cooling rates of chilled rolls of different diameters cast in chill molds of different thicknesses at different temperatures. HWG(12b)

Modern Steel-Pouring Plant. Some Characteristic Plant Layouts. K. R. BINKS. *Metallurgia*, Vol. 4, June 1931, pages 39–41.

Description of pouring equipment and some layouts in tonnage plants. JLG(12b)

Aluminium Sheet Production. ROBERT J. ANDERSON. **Part 6. Ingot Moulds.** *Metallurgia*, Vol. 13, Apr. 1931, pages 213–214; **Part 7. Ingot Pouring Practice.** May 1931, pages 15–16; June 1931, pages 63–65; **Part 8. Pre-treatment of Rolling Ingots.** July 1931, pages 85–88.

Part 6. Contains bibliography of 12 references. Tilting vertical book molds are generally used. A closed grained gray iron makes good molds. Molds usually fail by cracking or checking. The author favors the use of molds having polished faces. No mold dressing is necessary. Part 7. A detailed description of methods of pouring aluminum ingots that are to be rolled into sheet. 6 references. Part 8. Al alloys must be broken down hot. Some can be rolled immediately after they have cooled to a suitable temperature, but others must be maintained at an elevated temperature several hours before rolling. Preheating is the best practice for all alloys. Alloys may be scalped before rolling or after a slight reduction. Heating furnaces and scalping machines are discussed. 2 references. JLG(12b)

Rolling (12c)

Plain Bearings in Rolling Mills. (Gleitlager an Walzwerken.) W. ROHN. *Zeitschrift für Metallkunde*, Vol. 23, Mar. 1931, pages 76–86.

Includes discussion. It is stated that the wear on journals and bearings increases very rapidly with increasing rolling pressures. This wear can now be almost entirely prevented by cooling the bearing, best by copper tubes included in the bearing body. The discussion and illustrations furnish considerable engineering information. RFM+EF(12c)

Automatic Pressure Lubricating Systems for Roll Necks. M. RESWICK. *Iron & Steel Engineer*, Vol. 7, Oct. 1930, pages 503–505.

The author gives the advantages of automatic lubrication of roll necks and outlines the principles of several systems. WLC(12c)

Group Versus Individual Driven Rolling Mill Stands. R. H. ELLIS. *Iron & Steel Engineer*, Vol. 7, Aug. 1930, pages 429–431.

The author shows the mechanical advantages of group driving, the proper combinations thereof, and of individual drive. The nature of the product makes individual drive necessary on certain sheet, merchant and strip mill jobs. WLC(12c)

Modern Rolling Mills for Non-Ferrous Metals. (Neuzeitliche Walzwerke für Nichteisenmetalle.) E. PFANN. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 391–392.

Rolling mills with large rolling pressure. Largest equipment of this kind built for non-ferrous metals is described and illustrated. EF(12c)

Influence of the Degree of Rolling, Rolling Temperature and Cooling Conditions on the Mechanical Properties of Low-Carbon Steel. (Einfluss des Walzgrades der Walztemperatur und der Abkühlungsbedingungen auf die Mechanischen Eigenschaften von kohlenstoffarmen Flussstahl.) A. POMP & E. FANGMEIER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, May 23, 1931, pages 666–668.

Tests were conducted on bars of 0.08 C which were rolled from different initial thicknesses to the same final thickness. From the tests, it was concluded that the most favorable value of mechanical properties were always found at a rolling temperature of 900° to 1000° C.; at this point, the figures of normalized steel were equaled or even exceeded. For temperatures higher than 1100° C., overheating phenomena are observed which reduce the mechanical properties. At temperatures lower than 900° C., a reduction is also observed; although below 700° C., tensile strength, elastic limit and hardness are increased, while elongation, notch-toughness and grain size are decreased. Ha(12c)

Rolling Mill Lubrication. E. S. GLAUCH. *Iron & Steel Engineer*, Vol. 8, May 1931, pages 215–221.

The author covers the recent changes in rolling mill lubrication, description of special machinery erected for determining the coefficient of friction with various lubricants and the results of tests conducted on these machines showing that with proper selection of grease, savings as high as 25% could be made on power. WLC(12c)

Roll Pass Design. Part XXV. W. TRINKS. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 35–38, 50.

Collars are designed in blooming mill rolls to insure proper entrance of the semi-finished bloom and to protect against cracking of the steel. Width of collar at root about equal to depth, which seldom exceeds 3 in. Collar may taper 10 degrees. Diameter of roll at bottom of grooves must be kept almost constant. Number and size of grooves dependent on size of ingot and size of bloom desired. In general, a 20 × 20 in. ingot may be rolled to an 8 × 8 in. bloom in 3 grooves or to a 4 × 4 in. bloom in 5 grooves. Belly necessary on rolls to counteract central spreading of ingot in subsequent passes as surface becomes colder than the interior. JN(12c)

Investigations of Rolling Mill Furnaces. (Untersuchungen an Walzwerksofen.) L. A. RICHTER. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, pages 377–385.

Report 149 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. The article summarizes the data of investigations of rolling mill furnaces, compiled by the "Eisenhütte Oestereich" and obtained from rolling mill furnaces in Austrian steel plants. The furnaces investigated and methods of operation are described. Data of the heat balances and the material losses by oxidation are given. Relations between consumption of heating coal and production are established, as well as the relations between heat losses during the idling period and production. The relations between the surface area of the furnace and area of the hearth are dealt with. The heat consumption during the preheating period of the furnaces investigated and its dependence upon furnace surface area and hearth area is mentioned. GN(12c)

Manufacture of Cast Iron Rolls. (Die Herstellung von Gusseisen-Walzen.) E. PEIPERS. *Stahl und Eisen*. Vol. 51, Mar. 19, 1931, pages 345–351.

Report 83 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Including discussion. The article discusses the production and properties of plain cast iron rolls as well as chilled cast iron rolls for the various types of rolling mills. Special reference is made to the manufacturing of chilled iron rollls according to the two methods by Peipers and Weymerskirch. The composition of alloyed chill cast iron rolls is given. The composition of two American types of alloys for chilled iron rolls, Phoenix Metal and Adamite is mentioned. GN(12c)

Developments in the Design and Application of Antifriction Bearings to Rolling Mills. W. B. MOORE. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 27–34.

Recent developments in tapered roller bearings concerned with applications to new types of mills and with improvements in mounting practice. Correct mounting design requires close pass alignment, resistance to thrust as well as radial loads, easy assembly and disassembly, and perfect lubrication. Moore describes and illustrates with photographs and diagrams a standardized antifriction bearing mounting developed for steel mill roll necks with several adaptions for various special types of mill. Also describes and illustrates a standard mounting developed for pinion stands. JN(12c)

The Development of the Production of Thin Sheets of High Quality. (Das Feinblech in der Entwicklung zur Qualität.) H. KLEIN. *Stahl und Eisen*, Vol. 51, Feb. 12, 1931, pages 189–196.

The article considers, in a general manner, the development of sheet mills, application and requirements of sheets, selection of sheet bars and rolling procedure, various types of annealing and equipment, pickling, dressing, testing and packing of sheets. The various types of metal coating are considered. A résumé is given on the application of new types of steel for sheets, as stainless steels, copper steels, Armco-iron etc. Statistics on the consumption of sheets in the most important iron producing countries are included. GN(12c)

Recent Developments in Rolling Mill Table Construction. WILLIS MCKEE. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 23–26.

Most rolling mill tables formerly built with line shafts and bevel gear drives. Other early tables built with rope drives of wire or hemp. Cut gears and roller bearings introduced in recent years. Describes the two principal designs of overhung individually electrically driven rollers recently developed. Also describes the "Motor Roller," a new individually electrically driven table roller with an inbuilt motor. The motor revolves around a shaft that is held against rotation. The unit is self-contained, has no overhanging parts and requires very little space. The use of individually driven rollers eliminates the necessity of maintaining accurate table alignment. Magnetic rollers have proved very satisfactory for transporting steel whose temperature is not above 1200° F. JN(12c)

Resistance to Deformation and Flow of Material During Rolling. (Formänderungswiderstand und Werkstoffluss beim Walzen.) A. FALK & E. SIEBEL. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, pages 388–390.

Discussion of the above authors on E. Siebel's article in *Stahl und Eisen*. Vol. 50, 1930, pages 1769–1775. See "Investigation of the Resistance of Deformation of Low Carbon Steel in Hot Rolling between 700° and 1200° C.," *Metals & Alloys*, Vol. 2, June 1931, page 115. GN(12c)

Developments in Thin Gauge Strip and Sheet Production Methods. LLOYD JONES. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 43–45.

Discusses early attempts and recent developments in ferrous and non-ferrous production of light gage sheets and wide strip by continuous methods. The continuous hot strip process is suitable for any width of material but is uneconomical for thicknesses below 16 gage. For lighter gages, the material from the hot strip mill is finished by hot rolling in standard sheet and tin mills or by cold rolling in single or continuous cold mills. The writer has developed a new pack rolling process (U. S. Patent 1,680,522, Aug. 14, 1928) for hot strip which produces material as thin as 22 gage in widths up to 36 in. and promises the possibility of continuous hot rolling to any gage desired. JN(12c)

Cold Roll Forming of Metals. Part XII. D. A. JOHNSTON. *Metal Stampings*, Vol. 4, Jan. 1931, pages 25–28.

Discusses in detailed two manufacturing methods in cold roll forming practice and illustrates the rolls used in the manufacture of the door buck by each method. The first method uses ten sets of rolls to form the piece and a press brake at the end to complete the two 90° bends required. The second method completes the door buck with all bends in one rolling operation on a 16-spindle rolling machine, thereby materially reducing production costs. JN(12)

The Application of Pressure Lubricating Systems to Blooming and Continuous Mills. W. D. HODGSON. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 47–50.

Describes and illustrates typical installations of a mechanical pressure lubricating system for rolling mills. System consists essentially of one or more pressure grease tanks with a number of grease lines extending to the lubricator valves on the mill. The grease supply is regulated by means of compressed air. The air line is equipped with one or more solenoid air valves operated from an electric control panel. Any number of different greases may be used in the same system, requiring only separate grease tanks. The advantages of this system are: positive lubrication of inaccessible parts, removal of hazards of manual greasing, flexibility in adding additional units as required, adaptability to unusual installations, and use of multiplicity of greases in same system. JN(12c)

On the Rolling of Special Steels in Blooming Mills with Examples of the Pass Design. (Ueber das Auswalzen von Sonderstählen auf Blockstrassen mit Kalibrierungsbeispielen.) O. EMICKE. *Stahl und Eisen*, Vol. 51, Apr. 2, 1931, pages 417–428.

The article deals in detail with the effect of the resistance to deformation, the heat conductivity and the rolling temperature on the particular rolling condition of special steels. Special reference is made to the shapes of ingots used and their weights. Finally follows a discussion of the design of passes of blooming mills for this special purpose. The pass designs of reversing two-high blooming mills as well as of three-high mills are discussed. GN(12c)

Rolling Metal Foil. C. E. DAVIES. *Metallurgia*, Vol. 3, Feb. 1931, pages 141–143; Mar. 1931, pages 181–182.

Lead, tin or aluminum foil can be rolled as thin as 0.00025 in. The latter metal is the most difficult to roll because it hardens during rolling. Formerly thin foils were produced by pack or "book" rolling, but they are now produced in coils from 15 to 20 in. wide and weighing 100 lbs. Some of the mills used for foil rolling are described. JLG(12c)

Forging (12d)

Press Working and Forming of Metals. Part XXXII. The Hot Press Forging of Brass. E. V. CRANE. *Metal Stampings*, Vol. 4, Jan. 1931, pages 39–42, 72.

Lists α, β and γ phases of alloy brass with properties of each. Gives temperatures of forging required in practice for various compositions of brass and properties encountered. It is desirable in forging practice to use a blank which almost fills the die. This results in reduction of scrap loss and increased die life. Trimming of brass forgings is usually done cold. A number of small press forgings are illustrated. JN(12d)

Manufacture of Large Weldless Forged-Steel Pressure Vessels. JOHN L. COX. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, 1930, *Iron & Steel*, pages 49–60.

Includes discussion. Describes in detail the various steps taken in the manufacture of large weldless forged-steel cylinders for high-pressure boiler drums and for various uses in the oil-refining and chemical industries. It covers the melting, casting and heating of the ingot; cutting-off, piercing and expanding the billet; forging, treating and machining the cylinder; and illustrates a number of ways in which the ends of the cylinder can be closed. (12d)

Shearing & Punching (12e)

Construction of Sectional Round Blanking Die. EMIL PANEK. *Metal Stampings*, Vol. 3, Sept. 1930, pages 829–831.

Describes procedure for constructing a die of the 6 section type, in which the tool steel die parts are backed up by cast-iron blocks, cast integral with the shoe. Advantages are use of comparatively inexpensive materials, easy heat treatment, and readily replaceable sections. MS(12e)

Extruding (12f)

The Influence of Pressure and Temperature on the Extrusion of Metals. C. E. PEARSON & J. A. SMYTHE. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 335–381.

Includes discussion. See *Metals & Alloys*, Vol. 2, July 1931, page 135. (12f)

Progress in Extruding Metals. E. PFANN. *Metal Industry*, N. Y., Vol. 29, June 1931, pages 251–253.

The development of the light metal industry has led to the manufacture of heavy extrusion presses ranging from 2500 to 5000 tons pressure. For the extrusion of concentric tubes, there is a patented method of supporting the container so that alignment of axis of container with stem and piercing mandrel is possible. PRK(12f)

Machining (12g)

Machining of Aircraft Cylinder Barrels. C. H. DECKARD. *Western Machinery World*, Vol. 22, Aug. 1931, pages 345–347.

The methods and operations adapted by the Wright Aeronautical Corporation for accurately machining cylinder barrels for air cooled engines is described. There are eleven operations necessary to complete these forgings. These are as follows: 1. Rough turn outside diameter. 2. Load, bore, face, undercut and champer. 2A. Bore, turn, face, champer, form angle. 3. Form taper, turn two dias. face. 3A. Turn face and form taper. 4. Turn 36 fins and form undercut. 5. Heat treat. 6. Face ends, turn angles. 7. Mill threads. 8. Grind $^5/_8$ inch dimension taper. 9. Burr fins, break sharp edges. 10. Wash and clean. 11. Inspect, deliver to stock. Each operation is described in detail. WAT(12g)

Turning with Shallow Cuts at High Speeds. H. J. FRENCH & T. G. DIGGES. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 2, 1930; *Machine Shop Practice*, pages 55–86.

Includes discussion. In this paper a method is described for testing lathe tools under shallow cuts and fine feeds. See also *Metals & Alloys*, Vol. 1, Apr. 1930, page 476. (12g)

Cemented Tungsten Carbide. GREGORY J. COMSTOCK (Firth-Sterling Steel Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 993–1008.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion. The history of the development of tungsten carbide is traced, the method of preparation is described and the characteristics of different grades discussed and illustrated by micrographs. Application of different grades to various machining operations are discussed with reference to present uses and future development of the field for this tool material. WLC(12g)

Power Measurements on a Hack-Saw. (Leistungsversuche an einer Bügelsäge.) W. HALLICH (Tech. Hochschule, Dresden). *Berichte über betriebswissenschaftliche Arbeiten* (V. D. I. Verlag, Berlin), Vol. 2, 1929, pages 20–33, 12 figures.

Tests on a power hack-saw, cutting 0.44% C steel of 92,000 lbs./in.^{2} tensile, with cobalt-chrome hack-saw blades. Effects of pressure, of speed, and of the number of teeth to the inch, were studied, and are shown in many complex diagrams. HWG(12g)

Modern Cutting Tools for Machine Tools. J. B. RENNIE. *Edgar Allen News*, Vol. 9, Dec. 1930, pages 769–772; Jan. 1931, pages 785–788; Feb. 1931, pages 812–813.

Effect of cutting speed on hardness and tensile strength of material to be cut; power consumed in cutting medium steel and ordinary cast iron on a lathe; tempering and secondary heat treatment; hardening prior to secondary heat treatment; welding high speed steel tips on shanks; tool edges with or against grain; shank material; lack of recognized test for high-speed steel hardness; induced hardness of the work material in path of tool by cutting tool, are among subjects discussed in January instalment. February instalment illustrates 39 shapes of tipped tools, arranged in sets, and includes recommendations. MFB(12g)

Machineability of Steel. (Die Bearbeitbarkeit des Stahles.) F. RAPATZ, with discussion by K. KREKELER & H. STÄGER. *Schweizer Verband für die Materialprüfungen der Technik*, Report No. 47 of the *Eidgenossische Materialprüfungsanstalt* (Report of discussion No. 18) Nov. 1929, 30 pages.

A general explanation of the variables entering into the machinability of steel, including effect of structure, of speed, feed, cutting oil, heat-treatment of high speed tools, etc. Photographs of surfaces produced under different cutting conditions are shown. Hardness-temperature curves for carbon tool steel, high speed steel and tungsten carbide are given. Discussion centers largely around cutting oils. This is a sort of correlated abstract in itself, and is not suited to further abstracting. HWG(12g)

The Probable Speed of Machining. A. H. RODRICK. *American Machinist*, Vol. 74, Feb. 19, 1931, pages 307–309.

Discussion of the speed of cutting of various metals, depth of feed, lubrication and grinding of cutting tools. Gives a chart showing best probable speeds for cutting metals. RHP(12g)

The Machining of Aluminum Alloy Castings. (Die Bearbeitung von Aluminium-Gusslegierungen.) W. LINICUS. *Metallwirtschaft*, Vol. 10, May 22, 1931, pages 424–426.

Contains 6 references. The necessity for using tools of different shape for aluminum alloys from those used for heavier metals and different machining practice are explained. The main differences are small cutting angles and high cutting speeds. Suitable tools and practice are described in detail for turning, milling, filing, shaping, sawing, threading, drilling, broaching, grinding and polishing aluminum alloys. CEM(12g)

The New Alloys and Machine-tool Design. Part 4. Hand-actuated Work-holding Devices. FRANCIS W. SHAW. *Metallurgia*, Vol. 3, Apr. 1931, pages 209–212.

A description of various chucks. JLG(12g)

New Developments in Machining Aluminum and Its Alloys. R. L. TEMPLIN. *Metal Stampings*, Vol. 3, Oct. 1930, page 922.

Abstract of paper read before the Society of Automotive Engineers, Oct. 7–8, 1930. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 43. MS(12g)

The Influence of Chemical Composition and Heat Treatment of Steel Forgings on Machinability with Shallow Lathe Cuts. T. G. DIGGES. *Bureau of Standards Journal of Research*, Vol. 6, June 1931, pages 977–992.

The tests described in this report were made primarily as a study of lathe-tool performance with shallow cuts as affected by variations in chemical composition and heat treatment of the steels cut. The cutting tests were made dry with high-speed steel tools of a selected size, form, composition and heat treatment, with a feed of 0.0115" per revolution and 0.010" depth of cut. Comparisons were made of the Taylor speeds on the basis of equal tensile strengths when cutting 0.4% C (S. A. E. 1040), Cr-V (S. A. E. 6140), Ni-Cr (S. A. E. 3140 and 3435), Cr-Mo (S. A. E. 4140) and $3^1/_2$% Ni (S. A. E. 2340) steel forgings heat treated to give tensile strengths between 75,000 and 220,000 lbs./in.^{2}. This study also included consideration of the surface finishes of the various steel forgings as affected by the test conditions, the microstructures of the steels cut, and tool performance as affected by the additions of 3.5 to 11.7% Co to the customary 18% W type of high-speed tool steel. If machinability is measured by the cutting speed permitting the tools to last a definite time, then measurable differences were observed between the various steels cut in the lathe test with shallow cuts. The fact, however, that some given steel permits a higher cutting speed than another steel for some tensile strength which is the same for both materials does not necessarily indicate that the 2 steels maintain the same relationship for another tensile strength. Of the different steels cut in the lathe tests the plain carbon steel was the most difficult to machine other than an annealed Ni-Cr steel. The surface finish on the plain carbon steel was also considered to be inferior to that of the alloy steels. The results showed that the effect of changes in chemical composition of steel forgings upon their cutting speeds was dependent upon the tensile strength at which the comparisons were made. In the different steels cut with shallow cuts the most effective special alloying elements for improving machinability were the combinations of Ni and Cr or Cr and V for the high tensile strengths in the neighborhood of 180,000 lbs./in.^{2}, while Cr and Mo were the most effective in the lower range of about 90,000 lbs./in.^{2} WAT(12g)

Drawing & Stamping (12h)

How to Select Thin Plate for Deep Drawing. H. T. MORTON (Hoover Steel Ball Co.). *Metal Progress*, Vol. 18, Dec. 1930, pages 54–59.

Causes of defective automotive stampings are given as quality of steel, die design and machine set-up. The author's studies with material 0.250–0.300 inches thick is reported. Methods of test and control are discussed. Methods of finishing and annealing were studied. Guides to deep drawing quality are found in tensile strength and elongation. Surfaces must be free from seams, laps, scratches and decarburization. The steel must be clean, micrographs illustrate. WLC(12h)

Experiments in Wire-Drawing. Part I. Behavior of a Composite Rod. W. E. ALKINS & W. CARTWRIGHT (Thomas Bolton & Sons, Ltd.). *Institute of Metals, Advance Copy* No. 561, Oct. 1931, 11 pages.

In order to study the flow of metal during drawing, composite Cu rods were produced by drawing several tubes over a solid core. After annealing these composite rods were drawn in straight-sided dies of various tapers and the relative reduction of each layer determined. The percentage reduction of each layer was the same, and therefore equal to the percentage reduction of the rod as a whole. Further examination indicated that during drawing the boundary surface of each layer was a frustrum of a cone and that all such cones had a common axis and a common apex. The loci of incipient reduction, of equivalent stages of reduction, and of complete reduction were found to be a series of spherical caps, radially parallel to one another and bounded by the bearing of the die. Furthermore, all of these caps had a common center, which corresponded with the apex of the cone formed by the bearing of the dies. 4 references. JLG(12h)

Experiments in Wire-Drawing. Part II. Notes on the Relation between Reduction of Area by Cold-Drawing and Tensile Strength of H.-C. Copper. W. E. ALKINS. *Institute of Metals, Advance Copy* No. 562, Oct. 1931, 9 pages.

When tensile strength is plotted against percentage reduction of area a straight line up to about 15% reduction results. Above this the curve has the form of a rectangular hyperbola, one asymptote of which lies at 32.6 tons/in.^{2} When reductions are made by a series of draws rather than by one draw the tensile strength is less. For a single draft a 56% reduction was possible, but with more than one draft not over 40% reduction could be obtained at each draft. 1 reference. JLG(12h)

Aluminum Sheet for Stamping and Drawing. Part 11. R. J. ANDERSON. *Metal Stampings*, Vol. 4, Jan. 1931, pages 31–34.

The various tempers of aluminum sheet are produced by annealing and subsequent reduction in thickness by cold rolling at constant width. The system of temper classification is based on tensile properties and hardness. A. gives system of nomenclature for standard aluminum sheet with table of Shore scleroscope hardness for different tempers and gages. The greater the amount of deformation suffered in fabrication, the softer the material required. Consumers should adhere to standard tempers in the interest of shop standardization. The temper of the finished aluminum article is also influenced by the annealing methods employed. Coil and flat sheets usually annealed by batch methods while circles are best annealed in continuous furnaces. A. suggests routine tests for drawability and grain size in using aluminum sheet. JN(12h)

Construction and Operational Features of Four-Post Presses. FRED R. DANIELS. *Metal Stampings*, Vol. 4, Jan. 1931, pages 51–54, 67–68.

Complete, detailed description of principles, design, construction, theory, operation, special features and advantages of the four post press for metal stamping. JN(12h)

Die Pressing Brass and Copper Alloys. JOHN R. FREEMAN, JR. *Metal Industry*, N. Y., Vol. 29, June 1931, pages 254–255.

Paper read before Institute of Metals Division, N. Y., Feb. 1931. A description is given of the die pressing of brass and copper alloys, mention being made of die design, tolerances and alloy compositions. See *Metals & Alloys*, Vol. 2, Mar. 1931, page 72. PRK(12h)

Stamping Equipment Employed in Radio Manufacturing. W. T. FULTON. *Metal Stampings*, Vol. 4, Jan. 1931, pages 65–67.

Describes modern metal forming equipment found in Rochester, N. Y., plant of the Stromberg Carlson Telephone Manufacturing Co. Two inverted presses of special design blank and form 400 small steel pieces per minute. An automatic spring machine forms 34,000 small flat springs per hour. Large presses are used in progressive straight line production to form loud speaker frames and radio chassis bases. Relay cases are formed from sheet aluminum in three draws. An automatic screw machine division and an up-to-date heat treating division are included in the plant. JN(12h)

The Construction and Uses of Typical Dies. Part 1. EDWARD HELLER. *Metal Stampings*, Vol. 4, Jan. 1931, pages 19–23.

Describes and illustrates design and construction of two types of cut-off and three types of blanking dies used in metal stamping with explanations of the operation, applications and particular features of each type. JN(12h)

Lubrication in Forming Decorated Sheet Metal. F. J. GAVIN. *Metal Stampings*, Vol. 4, Jan. 1931, pages 59–60.

Discusses proper selection and application of lubricants to fabrication of previously decorated flat sheet and applies principles to forming of food closure caps. To choose the best lubricant for a particular requirement, Gavin suggests: (1) investigation of all types of lubricants, (2) trial of trade marked brands, (3) research by a competent chemist, and (4) consultation with technical staffs of lubricant suppliers. JN(12h)

Wire Manufacturing and Lead Patenting. C. B. PHILLIPS. *Wire & Wire Products*, Vol. 6, June 1931, pages 226–227, 248; *Iron Age*, Vol. 127, June 25, 1931, pages 2042–2044.

Description of the manufacturing process of wires from 0.014 to 0.148 in. in diameter in the plants of the Union Wire Rope Co., Kansas City, Mo. Chilled cast iron dies are used and annealing (air patenting) at 1650° to 1700° F. is applied. Ha(12h)

Influence of the Rounding of the Punch in Deep-Drawing Hollow Bodies from Thin Sheets. (Einfluss der Abrundung beim Ziehen von Hohlkörpern aus dünnen Blechen.) H. DRAEGER (Tech. Hochschule, Dresden). *Berichte über Betriebswissenschaftliche Arbeiten* (V. D. I. Verlag-Berlin), Vol. 2, 1929, pages 1–19, 48 figures, 9 references.

Besides the properties of the metal sheet used, the product of a deep-drawing process is affected by the radius of curvature of the punch and the die, and by the play allowed between punch and die in relation to the thickness of the sheet used. Disks were stamped from soft brass sheet of 0.30, 0.35 and 0.40 mm. thick and from medium hard steel sheet of 0.25, 0.28, 0.32, and 0.42 mm. thick. The disks ran from 60 to 110 mm. diameter, and were drawn down into cups in a 50 mm. diameter die with a 49.1 mm. diameter punch. The lips of the punch and die were given different radii of curvature. The pressure on the punch was measured and automatically recorded. For the materials and thicknesses tested, a radius of 3 mm. gave best results. The effect of the radius on the diameter and uniformity of diameter of the cups was studied. Over 1000 tests are plotted in the diagrams. Draeger states that a formula previously given by Ruhrmann for determination of the proper radius leads to erroneous conclusions. He also comments especially on the lack of adequate methods for evaluation of the suitability of sheet for deep drawing. HWG(12h)

Energy Consumption and Properties of Material in Drawing of Steel Wire with Increased Drawing Velocity. (Kraftverbrauch und Werkstoffeigenschaften beim Ziehen von Stahldraht mit erhöhter Ziehgeschwindigkeit.) A. POMP. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Apr. 18, 1931, pages 498–499.

In order to determine the relation between increased drawing velocity and drawing pull and mechanical properties of the drawn wire, 3 different kinds of steel were tested at speeds from 2.3 to 7.5 m./sec. The results show a reduction of power consumption up to 5% which was accompanied by corresponding improvement of the form-changing efficiency. The respective curves are straight lines if plotted on logarithmic paper. A formula for the energy consumption of 1 mm.^{2} reduction in section could be developed. The introduction of the wire into the drawing die at higher speeds was more difficult; especially reliable safety arrangements have to be made for the protection of the workmen. Ha(12h)

Pickling (12i)

Mechanical Pickling. J. C. WEAVER. *Metal Progress*, Vol. 20, July 1931, pages 64–67.

Mass production in pickling is described. WLC(12i)

Pickling—A Cleaning-Room Process. G. H. COOPER. *Foundry Trade Journal*, Vol. 44, June 11, 1931, page 398.

Deals with the various materials used for pickling and discusses briefly the different types of equipment that can be used in the construction of pickling tanks. OWE(12i)

The Pickling of Pipe Using Commercial Inhibitors. E. L. CHAPPELL & PAUL C. ELY (National Tube Company). *Industrial & Engineering Chemistry*, Vol. 22, Nov. 1930, pages 1201–1203.

Presented at the Cincinnati meeting of the American Chemical Society, Division of Industrial & Engineering Chemistry, Sept. 1930. 2 references. Conclusion: (1) The amount of pickling acid used in dissolving scale is approximately a constant, depending only upon the weight of scale on the pipe. (2) The amount of acid used in dissolving steel is a variable which can be controlled by an inhibitor. (3) A small amount of acid is wasted in spent pickle. (4) The practical efficiency of a commercial inhibitor may be estimated from a simple hydrogen evolution test. MEH(12i)

Solution of Scale in Pickling Steel. E. L. CHAPPELL & PAUL C. ELY (National Tube Company, Pittsburgh, Pa.) *Industrial & Engineering Chemistry*, Vol. 22, Nov. 1930, pages 1200–1201.

In pickling welded pipe 95% or more of the scale is dissolved. The undissolved scale is largely silicates. The rate of scale solution is about equal to the rate of metal solution in the absence of an inhibitor. The rate of scale solution is about the same with or without an inhibitor. Scale on pipe is more quickly and completely dissolved than scale in acid without metal. MEH(12i)

Pickling, A Modern Cleaning Method. J. C. WEAVER (Weaver Brothers Co.). *Metal Progress*, Vol. 18, Dec. 1930, pages 45–49.

The author enumerates several methods of scale removal and shows pickling to have advantages of lower cost of equipment, operation and that it is sure and efficient. Older and modern methods compared. Advances in control of the chemical action by means of inhibitors are described. WLC(12i)

Notes on Construction of Pickling Tanks. J. C. WEAVER (Weaver Brothers Co.). *Metal Progress*, Vol. 19, Mar. 1931, pages 77–80, 149.

Types of destructive action in pickling tanks are analyzed and suggested materials and 3 applications are discussed. WLC(12i)

Layout for Batch Pickling. J. C. WEAVER (Weaver Brothers Co.). *Metal Progress*, Vol. 19, Jan. 1931, pages 77–80.

Equipment and methods of batch pickling are described. WLC(12i)

Cold Working (12j)

The Compressing of Surfaces. (Das Drücken der Oberfläche.) HILMAR DOERING. *Oberflächentechnik*, Vol. 8, May 19, 1931, pages 107–108; June 2, 1931, pages 117–118.

By means of a finishing method called "compressing of surfaces," tests have shown that a strengthening of the material by about 15% can be obtained. See *Metals & Alloys*, Vol. 2, July 1931, page 136. Ha(12j)

Cold Heading-Die Life. A. S. JAMESON (International Harvester Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 313–350.

Paper presented before the 12th Annual Convention of the Society, Chicago, Sept. 1930. Includes discussion, 18 references to the literature and illustrated by 28 micrographs and charts. The maximum production depends upon the die steel, die design, die heat treatment, bolt material, and machine operation. Depth of hardness, structural normality, composition and surface hardness are discussed with relation to temperature of quench and production. The critical points are considered and quenched fractures illustrated. The decisive factor is the depth of hardness. See also *Metals & Alloys*, Vol. 2, Mar. 1931, page 73. WLC(12j)

Cold Rolling of Strip Steel and Its Development. STEPHEN BADLAM. *Iron Age*, Vol. 126, Dec. 18, 1930, pages 1842–1846; *Steel*, Vol. 87, Oct. 30, 1930, pages 61–63; Nov. 6, 1930, page 56; *Engineering*, Vol. 130, Dec. 12, 1930, page 759.

Abstract of paper read before American Iron & Steel Institute. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 44. VSP+MS+LFM(12j)

Installation of Tubes. (Das Einwalzen von Rohren.) RIES. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Feb. 1931, page 44.

Review of article by Siebel in Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf, Vol. 11, leaflet 8, 1929. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 385. MB(12j)

Cleaning (12k)

Correct Cleaning Practice before Electroplating. W. L. PINNER. *Houghton's Black & White*, Vol. 4, July 1931, pages 26–29.

A few solutions for cleaning the articles to be electroplated are described. Most methods use emulsification or saponification of the oils or fats which have been used in buffing and polishing. Ha(12k)

Recent Methods for the Cleaning of Greasy Metal Parts in Industrial Operations. (Neuere Verfahren zur Reinigung fettiger Metallteile in industriellen und gewerblichen Betrieben.) H. STADTLINGER. *Oberflächentechnik*, Vol. 7, Sept. 2, 1930, pages 164–166.

Physical and chemical methods are used to free metals of fat and grease. Burning, brushing, and boiling in steam belong to the first class. The chemical method uses certain solvents, such as petroleum, benzol, etc., or alkali degreasing agents which are not inflammable. A table is given showing the times required for removing of grease by boiling in different solvents. Ha(12k)

The Advantages of Electric Metal Cleaning. D. E. WILLARD. *Houghton's Black & White*, Vol. 3, Apr. 1931, pages 22–25.

The advantages of using electric current in the cleaning bath are said to be time saved in the cleaning operation, dislodging of caked-on deposits by mechanical action, diminishing of tarnish on non-ferrous metals, possibility of lower concentrations of cleaning solutions, occasional removal of carbon smut from steel. Electric cleaning and copper or zinc plating may be done with one solution. Tank construction and solutions are discussed and the electrical part described. Ha(12k)

Cleaning House Operation. J. T. LEWIS, JR. *Wire & Wire Products*, Vol. 6, June 1931, pages 230–231, 247.

The practical layout of a materials cleaning plant is described. Here, a straight line handling of material afforded a great saving to the manufacturer of nuts and bolts. Ha(12k)

Metal Cleaning Practice in Railroad Shops. C. H. McGirr & D. E. Willard. *Houghton's Black & White*, Vol. 3, Jan. 1931, page 26.

The design of efficient cleaning tanks, care and make-up of cleaning solutions are discussed. The factors which bring about rapid production and clean work are considered. Ha(12k)

Lead Film Protects Metal under Scale. E. T. Youd (Bullard Co.). *Metal Progress*, Vol. 19, May 1931, pages 56–59.

The author describes an electrolytic cleaning method with the work as cathode and lead anodes in a sulphate-chloride bath at 150–170° F. A slight film of lead is deposited as the scale is removed which protects the metal from hydrogen embrittlement and action of the bath. This lead film does not build up. WLC(12k)

Modern Metal Cleaning. *Brass World*, Vol. 27, Apr. 1931, pages 87–89.

Discusses modern cleaning technique of British electroplaters. The heating of the cleaning tanks, rinsing, types of cleaners, detergent materials, soap solutions and conclusions to be drawn are outlined. Scouring and mopping with subsequent acid dips are liable to remain in the cases of small installations, where large quantities of material are available. A study of grease and dirt picked up in the course of fabrication makes it possible to devise a cleaning solution best suited for the particular type of oily dirt. WHB(12k)

Polishing & Grinding (12l)

Setting Up Polishing Wheels. Carl F. Weber. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, pages 687–688.

Discusses advantages of having one man in charge of setting up all polishing wheels. Wasted time of operators is eliminated, the wheels last longer, operators' production is increased, and a better grade of work results. MS(12l)

Polishing Hard Carbides on the Diamond Lathe. W. A. Wissler (Union Carbide and Carbon Research Labs.). *Metal Progress*, Vol. 19, Apr. 1931, pages 49–52.

The author describes interesting experiences with the diamond grinding trade in reaching a satisfactory polishing method for the preparation of microsections of tungsten carbide. WLC(12l)

Specifying Close Limits is Futile Without Suitable Finish. R. E. W. Harrison. *Machine Design*, Vol. 3, Feb. 1931, pages 46–48.

In order to get an objective comparison of the quality of a finished surface, an electro-magnetic type sound detector was used in connection with a loud speaker. Photomicrographs and the sound measurements made it possible to set up a scale for the quality of finish on which a cost diagram could be developed. The proper use of finish can eliminate the often very unsatisfactorily high initial wear. Ha(12l)

Use, Care and Protection of Grinding Wheels. Walter B. Leonard (American Emery Wheel Works). *Metal Cleaning & Finishing*, Vol. 2, July 1930, page 579–582.

Conditions affecting the use of abrasive wheels are the speed of wheel and work, size and shape of pieces ground, composition and temper of metal, method of grinding, condition of machine, rigidity of foundation, wet or dry grinding, quality of finish desired, etc. Discusses the factors influencing the selection of grinding wheels, economies practiced through the use of certain types, correct operating procedure, and the precautions to be observed in the protection of grinding wheels. Among the most important factors in the selection of wheels are the amount of material to be removed and finish desired. For removing a large amount of material, coarser wheels should be used. For a smooth finish, a fine wheel should be used. Soft, free cutting wheels are the most economical. MS(12l)

Coloring (12m)

Colors in Aluminum by Plating, Dyeing, Oxidizing. J. D. Edwards. *Product Engineering*, Vol. 2, Mar. 1931, pages 107–109.

By plating aluminum with Ni, Cr, Au, Ag, Cu, Zn or brass, it is possible to obtain almost any metallic finish on it possible on other materials. By oxide coating, the impurities give a gray to black color. This is made use of in aluminum shingles. Oxide coating is produced by either chemical or electro-chemical action and makes a superior foundation for protective paints. Also, by immersing the electrolytically oxidized aluminum in a hot solution of a dye, the color is readily absorbed by the oxide. If alloys of aluminum are oxidized electrolytically, the alloying constituents have a decided coloring effect. In general, a wide variety of color, texture, luster, hardness and protective qualities can be made. Ha(12m)

Finishing of Gold Filled Articles. Andrew V. Re. *Metal Cleaning & Finishing*, Vol. 2, Aug. 1930, page 683.

To oxidize Au filled or plated particles, the Au should be removed first. They are then color buffed to a very high luster. The parts are placed for 5–8 min. in a good grade of metal cleaner held at the boiling-point. Oxidizing solution consists of 5 oz. $CuCO_3$ and 1 pt. NH_4OH, and is operated at 150–170° F. The parts are rinsed well in cold and hot H_2O, color buffed if necessary, and lacquered. MS(12m)

Oxidized Copper, Brass and Silver Finishes on Aluminum and Its Alloys. R. E. Pettit. *Monthly Review American Electroplaters' Society*, Vol. 17, Dec. 1930, pages 9–13.

The coloring or oxidizing of plated aluminum can be made just as well as in the case of other metals and depends on the skill of the operator and the methods used. For general use, preliminary nickel plating is recommended. The aluminum or its alloy is first cleaned for about 30 sec. in a hot mild alkaline cleaner such as 1 to 3 oz./gal. each of trisodium phosphate and sodium carbonate. This followed by a clean cold water rinse. A treatment with hydrofluoric acid or 3 parts nitric and 1 part hydrofluoric acid, depending upon the kind of material, follows at room temperature. After further rinsing, it is ready for nickel plating. This treatment changes somewhat according to the kind of material: cast, pure aluminum, or kind of alloy. The respective pretreatments are described. Copper, brass or silver may readily be plated over the nickel and these coatings oxidized to give the various colored effects by well known processes. Ha(12m)

The Coloring of Tin, Tin Lead, and Aluminum Foils. W. W. Rogers. *Metal Industry*, N. Y., Vol. 29, Aug. 1931, pages 341–343.

A detailed description is given of dye solutions and the method of applying them. PRK(12m)

Sand Blasting (12n)

A New Design of Sand-Blast Room. *Foundry Trade Journal*, Vol. 44, June 4, 1931, page 386.

A new design of Gutmann plant is described, in which a turntable is used, half of the table being inside and half outside the room. In this way, while the operator is sand-blasting work on the half inside the room, another man can remove the clean castings and substitute others for blasting. OWE(12n)

DEFECTS (13)

On the Origin of Flakes in Steel. C. Benedicks & H. Löfquist. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 115–124; 2 figures, 23 references; *Jernkontorets Annaler*, No. 11, 1929, pages 592–600.

Flakes are ascribed to lack of cohesion between dendrites, aggravated by sudden temperature changes and lack of equalization of temperature. Low casting temperature, prompt transference to soaking pits, forging without cooling below forging temperatures and cautious cooling after forging, are advised. HWG(13)

On Impurities in Metals. Francis Bitter. *Physical Review*, Vol. 37, June 1, 1931, pages 1527–1547.

In order to arrive at a satisfactory understanding of many of the properties of metals, especially ferromagnetic metals, it is necessary to take into account the distorting effect of impurities and of other irregularities in the crystal lattice. The present paper is an attempt to describe some of the corrections that must be applied to the usual model of a perfect crystal before it can be expected to reproduce the properties of actual substances. Starting with the usual law of force between any two atoms—repulsion for small distances, attraction for large distances—the distortion of the lattice in the immediate neighborhood of an atom of impurity is discussed, with especial reference to the significance of the formation of molecules. Phase distributions in substances capable of allotropy are described, together with the influence of impurities on such distributions. The existence of diffusion makes it possible to apply statistical mechanics to solid solutions. It is shown that, in general, atoms of impurities in solids do not exert long range forces on each other by means of the distortions they produce in the lattice. This makes it possible to give simple formulae for the distribution of concentration of the impurities. These distributions are sometimes far from uniform, and a phenomenon similar to opalescence in gases may occur. Applications of the above concepts to ferromagnetic solutions are pointed out, and it is suggested that the ferromagnetism of austenite containing in the neighborhood of 0.8% C. may be due to the presence of small granules of α-iron resulting from local fluctuations in the distribution of carbon atoms. WAT(13)

Brittleness in Copper. Clement Blazey. *Institute of Metals, Advance Copy* No. 563, Oct. 1931, 29 pages.

Work previously published indicated that a peculiar type of brittleness infrequently occurred in annealed arsenical copper. The present work shows that such brittleness is not confined to As-Cu, but can be produced in As-free Cu. The necessary conditions for production of brittleness appear to be a low oxygen content and the presence of a small amount of Bi. Brittleness can be developed by cold working followed by one of the following anneals: (1) below a certain critical temperature, which is usually about 650° C., (2) by slowly cooling from above this temperature, and (3) by quenching from above the critical temperature and reheating to slightly below it. When the Cu is quenched from an annealing temperature above the critical it is free from brittleness. The ease with which brittleness could be produced increased with decreasing O content. 5 references. JLG(13)

Causes of Failures of Sheet and Tin Sheet Rolls. (Brüche an Fein- und Weisblechwalzen und ihre Ursachen.) H. Fey. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, pages 391–392.

H. Fey summarizes an article on the above subject by J. S. Caswell in *Proceedings South Wales Institute of Engineers*, Vol. 46, 1930, No. 4, pages 311–452. (Sheet and Tinplate Rolls. *Metals & Alloys*, Vol. 2, Jan. 1931, page 11.) The article deals with the following subjects: Manufacturing of rolls, statistical research of failures of rolls, observations on temperature fluctuations of the rolls, rolling pressure during the rolling of plates and tin sheets, stresses due to the deformation work of rolling, torsion stresses, physical properties and investigations of the structure of plain cast iron rolls and chilled cast iron rolls, values and changes of value of the stresses during rolling, hair cracks and burned spots of the fractures. GN(13)

Research on Wrought-Iron Chains. The Nature of Defective Laminations in Wrought-Iron Bars and Chain Links. H. J. Gough & A. J. Murphy. *Iron & Steel Institute, Advance Copy* No. 8, May 1931, 19 pages.

The fractured surface of wrought iron sometimes reveals a lamination having a brittle, crystalline appearance. The layers have sometimes been referred to as "burnt." A 1 in. diameter bar of "Genuine Treble Best Wrought Iron" was found to have a defective layer and this layer was exhaustively studied. Analysis of the defective layer indicated 0.48% P and 0.38% Si. A thermal study indicated no transformation on heating or cooling. It was concluded that the combined P and Si content was great enough to suppress the α-γ transformation, and that the type of defect studied was caused by the inclusion of an imperfectly refined bar in the "pile." Grain refinement of such material does not result from heating. Mechanical tests proved that the defective layer was harder than normal iron, and less resistant to shock. The presence of such a layer can be detected by nicking and breaking a bar. Contains 9 references. JLG(13)

Ghosts in Large Steel Forgings. J. Fletcher Harper & Harold J. Stein. *Metal Progress*, Vol. 20, July 1931, pages 45–49.

A portion of a paper to be presented before the Boston Convention of American Society for Steel Treating, Sept. 1931, and to be published in greater detail with discussion in the Transactions. Brief literature study of "ghosts" is given and the properties of forgings containing such defects are discussed. Methods of detection illustrated by photographs and micrographs are given. WLC(13)

Identifying Causes of Boiler-Metal Cracking. F. G. Straub. *Power*, Vol. 73, May 26, 1931, pages 809–812.

The "embrittlement" of boiler material is discussed. In almost all cases where boilers have become embrittled they have been found to be free from scale and any indications of corrosion. The boiler water enters the small capillary crevices in the seams. Under the conditions of fluctuating temperatures and pressures in the boiler, the water in these spaces slowly concentrates until a high concentration results. This concentration takes place in the areas adjacent to the rivets, where the metal is usually highly stressed. The caustic attacks the highly stressed metal by penetrating between the grain boundaries. If the sulphate content of the water is high enough its precipitation will cause a protective formation over the metal and no cracking will occur. A number of micrographs and photographs are shown illustrating characteristic failures. WAT(13)

On the Embrittlement of Wrought-Iron Chain by Stress and the Superiority of Cast-Steel Chain. H. Kikkawa. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, Part 2, pages 195–198.

Wrought iron becomes brittle when overstrained, its impact value falling, sometimes to a third of the original value. Heat-treated 0.25% C, 0.7 or 1.5% Mn is preferred, because of higher breaking load, higher impact tensile strength, lower cost in sizes above 2" diameter of chain, and better low temperature impact resistance, as shown below.

	Izod ft.-lbs. at 22° C.	Izod ft.-lbs. at −21° C.
Cast Steel of 0.24% C, 0.35% Si, 0.55% Mn	52	43
Wrought Iron of 0.01% C, 0.10% Si, 0.08% Mn	14	6

The heat treatment of the cast steel is not stated. HWG(13)

The Ingot Phase in the Manufacture of Rolled Steel Products. Part VII. JOHN H. HRUSKA. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 55–56, 60.

Gives chemical analyses and microphotographs of inclusions found in various kinds of steel ingots. Suggests better pouring and teeming practice to eliminate scale-like surface inclusions. Slag-like inclusions found below surface show insufficient time allowed for "settling" of steel between tapping and teeming. Wide-spread defect of "abnormality" in steel due to presence of microscopic inclusions of oxidation products of slag materials. These inclusions best demonstrated by presence of "ghost-lines" in microscopic sections. Ghost-lines contain phosphorus, sulphur and some silicon, with the carbon content about the same as the rest of the specimen. JN(13)

A New Type of Inclusion in Cast Iron and its Relation to Manganese and Silicon Content. F. J. COOK. *Foundry Trade Journal*, Vol. 44, May 14, 1931, pages 335–336, 345.

It was found that inclusions of a bright glazy nature in cast iron caused H_2O to sweat through glazed areas when subjected to steam pressure. See *Metals & Alloys*, Vol. 2, July 1931, page 136. VSP(13)

Season Cracking of Brass. (Das Aufreissen von Messing.) F. OSTERMANN. *Metallwirtschaft*, Vol. 10, Apr. 24, 1931, pages 329–337.

Contains 13 references. It is well known that brass in the form of tubes, rod or sheet sometimes suddenly bursts apart after a short period of storage. This only occurs in cold worked brass and is due to heterogeneous internal strains. These are not the same as the homogeneous work-hardening strains and are not proportional to the hardness. They are of macroscopic size and cause a weakening rather than strengthening of the metal. Usually these internal strains can be removed by annealing at low temperatures, at which the hardness is not affected. Bursting of strained brass is caused by the corrosion of ammonia and ammonium salts which are present in air in small quantities. This occurs along the grain boundaries and causes intercrystalline fracture. Brass actually has an affinity for ammoniacal gases. Acids attack brass uniformly, not along grain boundaries, and do not cause bursting. An accelerated test for bursting tendency is to dip the brass in a 1% $HgNO_3$, 1% HNO_3 solution for several minutes. Hg forms a weak, brittle alloy along the grain boundaries, which causes bursting if the metal is internally strained. The Hg test cannot be used to compare brasses of different composition or surface condition as these factors influence the rate of Hg and atmospheric attack in different proportions. Pure α brass with 63% Cu corrodes faster than $\alpha + \beta$ brass with 61–62% Cu. Corrosive attack will cause bursting only if the surface of the metal is under tensile stress and the interior of the metal is under compressive stress. The manner by which the internal strains are set up during rolling and cold working of bars, sheets and tubes are described and methods for the determination of the longitudinal and tangential stresses are given. In tubes the strains increase (1) with increasing wall thickness, (2) with greater reduction of the diameter and (3) by hollow drawing, in contrast to drawing over a fixed mandrel. When brass sheet is bent the strain is proportional to the angle of bending and the reduction during rolling. In brass containing 60% Cu the strains are very high, with 63–70% Cu they are less and with 85–90% Cu very low. Fe up to 0.15% and Pb up to 1.26% increase the strains slightly, Sn up to 1% decreases them slightly. The tendency of sheets and rods to burst is not directly proportional to amount of cold reduction, but is highest with 20–22% reduction, then decreases again. The only way to prevent bursting of strained brass is by removal of the strains by annealing. The temperature depends on the Cu content, time and amount of internal strain. For 60/40 brass 200°–250° C. is sufficient, for 70/30 250°–300°. For very hard brass it is difficult to keep the annealing temperature below the softening temperature. The internal strains can be reduced to a minimum by properly selecting and closely controlling manufacturing processes. The tendency to burst is reduced by storing in dry places. CEM(13)

CHEMICAL ANALYSIS (14)

Effect of Illium Crucibles on Volatile Determinations in Coal. J. A. ADDLESTONE. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, page 422.

Data are shown which indicate that the volatile-matter determination as made in illium crucibles gives results consistently lower than those obtained by the standard method with the use of platinum crucibles. MEH(14)

Determination of Titanium in Alloy Steels. (Bestimmung des Titans in legierten Stählen.) J. AREND & H. SCHELLENBACH. *Archiv für Eisenhüttenwesen*, Vol. 4, Nov. 1930, pages 265–267; *Stahl und Eisen*, Nov. 27, 1930, pages 1681–1682.

The authors developed 2 new methods for the determination of Ti in alloy steels either of which can be easily made with sufficient accuracy. Both methods, a gravimetric one and a colorimetric one, are described in detail. The colorimetric method gives correct results (deviation, 0.005%) for Ti contents up to 0.5%. The values obtained with both methods are in accordance. GN(14)

The Determination of Silver in Steel. (Silberbestimmung in Stählen.) WALTER BERG. *Chemiker-Zeitung*, Vol. 55, Apr. 4, 1931, page 259.

A 10–15 gm. sample is dissolved in 1:1 HCl and evaporated to dryness, taken up in 1:1 HCl and filtered. The precipitate on the filter is dissolved in NH_4OH, filtered and reprecipitated with HCl and saved. H_2S is passed through the first filtrate, the precipitate filtered, dissolved in aqua regia, evaporated to dryness and redissolved in HCl. The solution is made alkaline with NH_4OH and Fe is filtered off. It is then made weakly acid with HCl and combined with the other HCl solution. AgCl is filtered off and determined in the usual manner. CEM(14)

Application of the Spectrograph to the Analysis of Non-Ferrous Metals and Alloys. H. W. BROWNSDON & E. H. S. VAN SOMEREN. *Institute of Metals, Advance Copy* No. 564, Oct. 1931, 17 pages.

Part I discusses the field and advantages of spectroscopic analysis as applied to metals and alloys. Part II gives detailed directions for the quantitative spectroscopic determination of various elements in brass. The method for estimating the quantities present consists in a comparison of the intensity of certain lines of the element in consideration with the intensity of certain Cu lines. Tables that make this possible are given for Pb, Sn, Fe, Ni, Al and Mn. They are for use with arc spectra. Part III contains similar data for Pb. Spark spectra are recommended. The tables are for Sn, Sb, Cd, As, Bi, Cu, Zn and Ag in Pb. Th and Hg lines have also been found in commercial Pb, and the intensities of such lines for a given amount of these elements are given. JLG(14)

Apparatus for the Commercial Determination of the Total Zinc Coating on Steel. (Apparatur zur betriebsmässigen Bestimmung der gesamten Zinkauflage auf Stahl.) GOEKE. *Chemische Fabrik*, Vol. 4, Apr. 1, 1931, pages 147–148.

The weighed sample in the form of wire or sheet is introduced into a 100 cc. glass stoppered bottle, which is connected with a 100 cc. burette. A measured amount of a normal HCl + 3% $SbCl_3$ solution is added and the acid displaced by the liberated H_2 is measured in the burette. From this the weight of zinc is calculated. The method is quick, simple and accurate. CEM(14)

Determination of Magnesium with 8-Hydroxyquinoline—Gravimetrically, Volumetrically and Colorimetrically. W. A. HOUGH & J. B. FICKLEN *Journal American Chemical Society*, Vol. 52, Dec. 1930, pages 4752–4755.

Quick determinations of magnesium can be made by precipitating it as the salt of 8-hydroxyquinoline and estimating the magnesium content of the salt either gravimetrically, etc. In many cases where the saving of time is an important factor and extreme accuracy is secondary, one of these methods may prove useful. None of the other metals commonly found in natural waters will react with the reagent except calcium. MEH(14)

The Titration of Free Cyanide in Copper Baths. M. R. THOMPSON. *Monthly Review American Electroplaters' Society*, Vol. 18, May 1931, pages 31–37.

Describes a method of titration with potassium iodide. Ha(14)

The Spectrographic Assay of Some Alloys of Lead. D. M. SMITH. *Institute of Metals, Advance Copy* No. 581, Oct. 1931, 15 pages.

The possibility of applying spectrographic methods to the routine analysis of Pb alloys containing Cd, Sb and Sn was investigated. The method was found to be quite satisfactory for estimating quantities less than 1%. The spark method is the more accurate. Analyses were made both by comparing the intensities of certain lines in the element to be determined with Pb lines and by the logorithmic sector method. 5 references. JLG(14)

Analytical Standards in the Laboratory. F. J. WATSON & R. E. SUMMERS, *Chemical Engineering & Mining Review*, Vol. 23, June 5, 1931, pages 349–354.

A portion of the opening address at a discussion of the subject held by the Analytical Group of the Australian Chemical Institute (Victorian Branch) Apr. 15, 1931. A discussion including the standardization of volumetric glassware, analytical standards and working standards. The standards authorized throughout the I.C.I. are: (1) ultimate standard—pure Ag, (2) working standards—iodine, sodium sesquicarbonate, NaCl, (3) secondary working standards—sodium oxalate, and arsenic trioxide. A diagrammatic scheme shows the standardization system based on pure Ag. WHB(14)

Determination of Zinc with Pyridine and Ammonium Thiocyanate. C. FRANKLIN MILLER. *Chemist-Analyst*, Vol. 20, May 1931, pages 8–10.

This method is particularly suitable for the analysis of zinc salts and is quicker and more accurate than the phosphate method. To a neutral solution containing about 0.3 g. Zn in 500 cc., 4 g. of NH_4SCN and 2 g. pyridine dissolved in a small amount of water are added. The precipitate is filtered on a Gooch crucible and washed with (1) 3 g. NH_4SCN + 5 cc. pyridine/liter, (2) 13 cc. 95% alcohol + 85 cc. H_2O + 1.5 cc. pyridine + 0.1 g. NH_4SCN, (3) 10 cc. absolute alcohol + 1 cc. pyridine, (4) 15 cc. ether + 2 drops pyridine. The precipitate is dried at 65–70° and weighed. It contains 19.25% Zn. CEM(14)

Investigations on Helium. VIII. Quantitative Determination of Very Small Amounts of Helium. (Heliumuntersuchungen. VIII. Ueber eine Methode zur quantitativen Bestimmung kleinster Heliummengen.) F. PANETH & WM. D. URRY (University of Königsberg). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 152, Jan. 1931, pages 110–126.

Method for determining quantities of He between 10^{-4} to 10^{-8} cm.^{3} in metals. EF(14)

Identification of Aluminum and Magnesium in Printing Inks. LOUIS M. LARSEN. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, pages 416–417.

Three references. The identification of both Al and Mg involves the use of lake-forming dyestuffs, capable of detecting small quantities of the above elements in the presence of other ingredients in inks (and pigments). These dyestuffs are aluminum for Al and benzopurpurine 4B for Mg. Procedures are given. MEH(14)

Titration of Lead by Means of a Thermionic Titrometer. R. W. GELBACH & K. G. COMPTON. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 2, Oct. 15, 1930, pages 397–398.

Two circuits, one a three-tube, and the other a two-tube titrometer, are described and shown by diagram, for determining the equivalence point in the titration of lead nitrate with potassium chromate. No curves are required. MEH(14)

Modified Gravimetric Determination of Manganese. FREDERICK G. GERMUTH. *Chemist-Analyst*, Vol. 20, May 1931, page 11.

In precipitating $MnO(OH)_2$ from H_2SO_4 solutions the use of fuming H_2SO_4 and $K_2S_2O_8$ instead of $(NH_4)_2S_2O_8$ is recommended. The precipitate coagulates readily and is easy to filter. Ignition at 1000° C. converts it to Mn_3O_4. CEM(14)

Germanium in Meteors of Cranbourne. (Ueber das Vorkommen des Germaniums in Meteoriten von Cranbourne.) V. M. GOLDSCHMIDT (University of Göttingen) *Zeitschrift für physikalische Chemie*, Sect. A Vol. 146, Mar. 1930, pages 404–405.

Chemical and X-ray spectrographic analysis yielded 0.1% of this rare element besides traces of Cu, Zn, Ga, As, Pb, Sn, Mo, Ru, Pt, Ir, Pa, Rh, Ag, Os and Au. EF(14)

A Modification of Penny's Method for Determining Iron in Iron Ores. ROY P. HUDSON. *Chemist-Analyst*. Vol. 20, May 1931, pages 6–7.

The bichromate titration with an internal indicator has several advantages over the permanganate method. 0.5 g. of ore is dissolved in 10 cc. HCl and reduced with $SnCl_2$. After heating to complete solution, $KMnO_4$ is added, then $SnCl_2$ to complete reduction and 1 cc. excess. The solution is cooled and diluted and 8–10 drops 1% diphenylamine solution added. Then 1 cc. $HgCl_2$ and 20 cc. H_2SO_4 – H_3PO_4 are added and the solution titrated until the green color changes to deep blue. CEM(14)

HISTORICAL & BIOGRAPHICAL (15)

Ups and Downs of Titanium. G. F. COMSTOCK. *Metal Progress*, Vol. 19, Apr. 1931, pages 58–63.

The history of titanium recovery is outlined. The use of titanium as a deoxidizer is described particularly with reference to metal for rails. WLC(15)

The True Story of Wrought Iron. J. A. COMSTOCK. *Industrial Record*, Mar. 1931, pages 23–24, 56, 60.

A non-technical history concluding with practical hints. MFB(15)

An Egyptian Axe-Head of Date 1800 B.C.: Its Investigation and Reproduction. H. C. H. CARPENTER. *Nature*, Vol. 127, Apr. 18, 1931, pages 589–591.

Investigation showed, by etching with $(NH_4)_2S_2O_8$, a dendritic structure composed of an alloy of high Cu content. Dendritic structure also showed that the axe was cast. Brinell hardness showed 90 on flat to 112 at the edge. Chemical analysis gave 96.9% Cu, 1.5% As, 0.7% Fe and 0.2% Sn. The remaining 0.7% was Ni, S and O. The axe-head was reproduced, using an alloy of the same shape and composition and was subjected to mechanical and thermal treatments which microscopic and hardness treatment showed in the Egyptian axe-head. Investigation showed that hardening by cold work is permanent in this type of alloy. VSP(15)

Pioneering at Midvale. JOHN L. COX & F. B. FOLEY (Midvale Co.). *Metal Progress*, Vol. 18, Nov. 1930, pages 51–55.

The authors sketch historically the developments in the metallurgical art made at Midvale. The open hearth, pyrometry, high speed tool steel, and automotive and ordnance alloy steels are among the subjects of Midvale's pioneering. WLC(15)

Nickel—Its History, Refining and Uses. H. W. WALTER. *Canadian Chemistry & Metallurgy*, Vol. 15, July 1931, pages 185–191.

A paper presented at the Canadian Chemical Convention, Montreal, May 27–29, 1931. Sources of Ni, smelting operations at Copper Cliff, refining from Bessemer matte, the Mond and the Hybinette processes are discussed. Charts show the flowsheet of operations at the Port Colborne refinery and the flowsheet showing the flow and purification of electrolyte. Uses are also discussed. WHB(15)

Development and Progress of Rolling Mill Practice in Japan. G. NAGATA. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, pages 639–666.

In English. Description of Japanese Mills. HWG(15)

A Unique Iron Meteorite from Mexico. H. H. NININGER. *American Journal of Science*, Vol. 22, July 1931, pages 69–71.

While in Mexico City in November 1929, the writer was shown a meteoric fragment weighing 24 lbs. which had been presented to the Director of the National Observatory. Cut into the iron was a legend to the effect that it had come from within the city of Chihuahua. Through the courtesy of the Director a small pièce was cut off for the purpose of study and identification. Polishing and examination under a lens showed the structure to be largely dendritic schreibersite in minute granules. The distribution of these granules was of two kinds (1) they were scattered variously throughout the metal and (2) they were arranged in pairs of parallel rows, a pair of which together with an included strip of about the width of one row, measured about a millimeter across. Chemical analysis of the sawings from this meteorite was made with the following results:

Fe	91.16	Cu	0.14	S	0.07
Ni	6.96	Cr	0.02	C	0.05
Co	0.40	P	0.42	SiO_2	0.06

WAT(15)

Historical Sketch of Minting Work in Japan. T. HIROSE. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol 36, *Mining & Metallurgy*, Part 4, pages 65–78. (In Japanese, English abstract.)

Four Japanese prints of ancient minting operations are shown. Historical, with some comment on present methods, which are said to be quite similar to those of other mints. HWG(15)

Chronology of Iron and Steel. Compiled by STEPHEN L. GOODALE. Penton Publishing Company, Cleveland, 1931. Cloth, 4 × 6½ inches, 332 pages. Price $4.15.

The first edition of this book briefly chronicled the more important events in the iron and steel industries from biblical times up to and including the year 1919. The new edition is only an extension of this information to include the first quarter of 1931.

The book is arranged chronologically, that is, the years are listed in order and under each are mentioned new processes, new equipment and all other important developments that occurred in the iron and steel industry in that year. It also includes a complete index in which the events, processes, etc., are arranged alphabetically, with a reference to the years under which they may be found.—RICHARD RIMBACH(15)-B-

The Swedish Acid Bessemer Process. (Den svenska sura bessemerprocessen.) ARVID JOHANSSEN. *Jernkontorets Annaler*, Vol. 115, May 1931, pages 239–278.

Historical. 46 references from Jernkontorets Annaler 1858–1920. HCD(15)

The History of Impact Testing. (Historique de la découverte et du développement des applications de l'essai au choc sur barreaux entaillés pour déceler la fragilité de l'acier.) HENRY LE CHATELIER. *Revue de Métallurgie*, Vol. 28, May 1931, pages 245–253.

Considere discovered that steel might be fragile and that this fragility cannot be discovered by tensile testing (Bulletin de l'Association des Ingénieurs des Ponts et Chaussées du Sud-Ouest, Jan. 18, 1888). André Le Chatelier found in 1892 that this property can be demonstrated by using a specimen notched with a saw and subjected to an impact test. The original testing involved the number of the hammer blows required for breaking the specimens. Frémont in 1897 proposed the determination of the resiliency of the sample from the loss of the energy stored in the weight breaking it. Charpy inspired by the work of Russel suggested, in 1900, the use of a pendulum for breaking the specimen also using a notched specimen and determining the loss of energy of the pendulum. Guillery used, for breaking of the sample, a rapidly rotating fly wheel measuring the drop of speed in the moment of breakage. Izod improved on the ideas of Charpy. JDG(15)

Fifty Years of Physical Metallurgy. H. M. BOYLSTON. *Proceedings of the World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*. Part 4, pages 197–209.

See *Metals & Alloys*, Vol. 1, July 1930, page 626. HWG(15)

ECONOMIC (16)

The Development of Electrolytic Metals in Canada. W. R. MCCLELLAND. *Canadian Mining Journal*, Vol. 52, May 8, 1931, pages 470–474.

A brief record of what has been accomplished and possibilities of further expansion. Aluminum, cadmium, lead, nickel and zinc are reviewed; and magnesium, beryllium and iron are pointed out as possibilities. WHB(16)

Tin in 1929. CHARLES WHITE MERRILL. *Mineral Resources of the United States*, 1929, Part 1, Apr. 25, 1931, *United States Bureau of Mines*, pages 333–362.

In 1929 the U. S. imported for consumption 87,127 long tons of tin (an increase of 12%) reclaimed 30,625 tons (a decline of 4%) and produced 35 tons (Alaska 34.5 tons). Tin stands tenth in value among the commodities imported for consumption in the U. S. and accounts for 2.1% of the total domestic imports. World mine production of tin in 1929 was 185,000 long tons, an increase of 4% over 1928. Federated Malay States produced 36%, Bolivia 25% and the Netherland East Indies 17%, 78% from 3 countries. Straits Settlements (1/2), United Kingdon (1/3) and Netherland East Indies (1/7) smelted over 90% of the total. AHE(16)

The Basic Bessemer Process. Some Considerations of Its Possibilities in England. VERNON HARBORD. *Iron & Steel Institute, Advance Copy* No. 9, May 1931, 17 pages.

The basic Bessemer is extensively used on the Continent, but has been almost entirely superseded by the basic open-hearth in Great Britain. The basic Bessemer requires a particular type of iron for successful operation. The ores available for producing such iron are discussed. It is concluded that the possible saving with the basic Bessemer amounts to about 7s. per ton. The Bessemer process has the advantages of lower labor cost, lower plant cost, lower fuel consumption, regular delivery of ingots in small quantities, and a higher credit for the slag. It has the disadvantages of a lower ingot yield, allowing little scrap use, of not using blast furnace or coke oven gas, and of less control of the process. Contains 2 references. JLG(16)

Gold, Silver and Copper in Wyoming in 1929. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, Apr. 20, 1931, pages 271–273.

In 1929, Wyoming metal mines produced gold worth $995 ($677 in 1928), 26 ounces of silver worth $14 (53 oz., $31 in 1928) and 4,301 pounds of copper worth $757 (2,604 lbs., $375 in 1928) for a total of $1,766 ($1,083 in 1928). AHE(16)

Gold, Silver and Lead in South Dakota in 1929. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, April 20, 1931, pages 265–270.

Gold production in South Dakota in 1929 was 316,836.85 oz., worth $6,549,599, a slight decrease from 1928; silver output was 85,182 oz., worth $45,402, a decrease of about 6 and 14%, respectively. Almost all of this production is from the Homestake mine, the largest producing gold mine in the United States and a continuous producer since 1875. AHE(16)

Copper in 1929. C. E. JULIHN & H. M. MEYER. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, June 3, 1931, pages 525–580.

In 1929 smelter output of copper from domestic ores was 2,002,863,135 lbs., refinery production of new copper was 1,982,732,298 lbs., world smelter production was 4,199,805,000 lbs., all the largest ever recorded. North America supplied 59%, South America 19%, Europe 9%, Africa 8% and Asia 4%. 5 references. AHE(16)

Gold, Silver, Copper and Lead in Oregon in 1929. V. C. HEIKES. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, May 15, 1931, pages 471–483.

The total value of the mine production of gold, silver, copper and lead in Oregon in 1929 was $486,000, an increase of 64% over 1928. There were increases in the output of all metals except silver. AHE(16)

Gold, Silver, Copper, Lead and Zinc in California in 1929. V. C. HEIKES. *Mineral Resources of the Unites States*, 1929, Part 1, *United States Bureau of Mines*, May 15, 1931, pages 431–470.

The output of gold, silver, copper and lead from California mines in 1929 was valued at $15,090,589, a decrease of 2% compared with 1928. Gold decreased 21%, silver 20% in quantity and 27% in value and lead 24% in quantity and 18% in value. Copper increased 32% in quantity and 61% in value. No zinc was reported produced. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Washington in 1929. C. N. GERRY & T. H. MILLER. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, Apr. 31, 1931, pages 413–430.

The value of the mine production of gold, silver, copper, lead and zinc in Washington in 1929 was nearly 13% less than in 1928. The large decrease in the output of gold and silver offset the decided increase in the output of copper and zinc. Lead output decreased slightly. AHE(16)

Production and Applications of Light Metals and Their Alloys in Italy. (Produzione ed applicazioni dei metalli leggeri e loro leghe in Italia.) A. W. BONARETTI. *Metalli Leggeri*, Vol. 1, Jan.-Feb. 1931, pages 7–17.

Stresses Italy's lack of iron ore and coal, which leads to the need of greater utilization of her stores of ores of the light metals and her hydro-electric power to produce metals for national defense. Italy now has capacity for production of some 15,000 tons of Al and 500 tons of Mg per year. She may have beryllium ores for use when that metal comes into commercial use. Of 8,000 tons Al produced in Italy in 1930, 20% went into electrical conductors, and 40% each into other wrought forms and into castings. The advantages of light metals and alloys for electrical conductors and for construction of all kinds of vehicles for transportation are discussed at length, with a list of several hundred applications. HWG(16)

Gold, Silver, Copper, Lead and Zinc in Idaho in 1929. C. N. GERRY & T. H. MILLER. *Mineral Resources of the United States*, 1929, Part 1, *United States Bureau of Mines*, Apr. 31, 1931, pages 363–412.

The value of the mine production of gold, silver, copper, lead and zinc in Idaho increased from $26,667,706 in 1928 to $31,104,246 in 1929. The quantity of all except gold increased materially. The output of zinc was the largest ever recorded in the state. 19 references. AHE(16)

The Italian Production of Cadmium—the Process at the Monteponi Plant. (La produzione nazionale del Cadmio. Il processo e l'impianto di Monteponi.) L. CABMI & V. TOJA. *Giornale di chemica industriale ed applicata*, Vol. 13, June 1931, pages 281–296.

World cadmium production has risen, along with the increase in electrolytic zinc, from 230 tons in 1914 to 1780 tons in 1929. In the latter year, the U. S. produced about 1125 tons. The Monteponi plant in Italy can produce 30 to 35 tons a year. The ore used contains about 21% Zn and 0.05% Cd. The Cd is thrown down from the H_2SO_4 solution as cement cadmium by zinc dust. The fine precipitate oxides rapidly, and the oxides are dissolved with H_2SO_4 plus a little HNO_3. The solution is purified with iron sulphate and with permanganate, and ferric hydrate and manganese compounds precipitated with lime, giving a solution with about 83 g. Cd, 21 g. Zn per liter. The cathodes are moved up and down at 90 strokes per minute, and the electrolyte is agitated intermittently and held at 40–45° C. The current density is 50 amps./m.², and the current efficiency 98.4%. 1.7 KWH is required for 1 kg. of Cd deposited. Very compact cathode deposits are obtained. These are stripped, melted under heavy oil and then remelted under fused NaOH. The resultant Cd runs 99.92%, containing 0.033% Zn, 0.041% Pb, 0.004 Fe, and no Cu. HWG(16)

The World's Production of Minerals and the Modern Prospecting. (La production mondiale de minerais et la prospection moderne.) CH. BERTHELOT. *Revue de Métallurgie*, Vol. 28, May 1931, pages 289–301.

After giving statistical information regarding the mineral industry of the world the author gives some data regarding cost and methods of prospecting and organizations of mining undertakings. JDG(16)

The Limits to Specifications; the Costs of Accuracy. (Grosszahlforschung und Normung.) DAEVES. *Automobiltechnische Zeitschrift*, Vol. 34, Apr. 20, 1931, page 271.

Limits and specifications on mass production products must depend upon the variable curve of the individual product if costs are to be within reason. In a specific example the curve is set up for the carbon content in steel. Maximum variable was found to be 0.1%. If the carbon content was to be kept between 0.14 and 0.16% then rejections are reduced to 11% of the product. If another 0.1% is added to either limit (0.12 and 0.18) then only 2.5% of the product need be rejected. The purchaser then must consider his limits from the standpoint of accuracy as compared with the costs of accuracy dependent upon the particular variable curve. WHB(16)

The Iron and Steel Industry of Japan. S. HATTORI. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Vol 33, published 1931, *Mining & Metallurgy*, Part 1, pages 43–78.

Historical account, with present status. Japan lacks good coking coal and her iron sands are titaniferous and give difficulty in smelting. Statistics of blast furnaces, open hearth and rolling mill capacities are given. There are some 20 electric iron furnaces of less than 500 K. W. and 43 from 500 to 3000 K. W. HWG(16)

Copper and Its Alloys. WM. CRAWFORD HIRSCH. *Electrical Manufacturing*, Vol. 8, July 1931, pages 33–34.

About 47% of the world's copper is produced in the United States. The price has dropped from 23½ cents a pound in March 1929 to 8½ cents in June 1931. The three principal grades of copper are; electrolytic, Lake Superior, and casting copper from ore and scrap. There are approximately 14 tons of electrolytic copper used to every ton of Lake copper. The consumption of casting copper, as compared to electrolytic is trifling, amounting to 5000 tons in an average year. No figures are available on the amount of copper used in its alloys. WAT(16)

The Natural Resources of the Iron and Steel Industry in Sweden. A. JOHANSSEN. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 31–42.
The pure ores of Sweden will suffice for many years. Probable future shortage of charcoal can be met by wider use of electric furnace processes. HWG(16)

The World's Iron Ore Supply. C. K. LEITH. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 1–30.
Extended discussion of the iron ore situation in all countries, from the economic, military and political points of view. HWG(16)

Effect of the Fall in Metal Prices on Base-Metal Mining. WILLIAM PELLOW-HARVEY. *Metal Industry*, London, Vol. 38, May 29, 1931, pages 551–553; June 5, 1931, pages 575–576; June 12, 1931, pages 606–607.
Condensed from Presidential Address to Institution of Mining and Metallurgy, May 21, 1931. Statistics are given of the production, prices, and values of the various common metals produced in the British Empire. PRK(16)

Cadmium. W. G. RUMBOLD. *Canadian Mining Journal*, Vol. 52, May 15, 1931, page 456.
A reprint from *Mining Magazine*. An expanding market in cadmium is met from the electrolytic zinc plants in Tasmania, Canada and the U. S. WHB(16)

Economic Aspects of Sponge Iron Production in Canada. BRADLEY STOUGHTON. *Transactions Canadian Institute of Mining & Metallurgy*, 1930, Vol. 33, pages 74–79; Discussion, pages 80–98.
See *Metals & Alloys*, Vol. 1, page 570. AHE(16)

Zinc in 1929. ELMER W. PEHRSON. *Mineral Resources of the United States*, 1929, Part 1, July 6, 1931, pages 675–727, *United States Bureau of Mines*.
The production of primary Zn in 1929 (625,447 short tons) was the largest since the war. Production from domestic ores increased 3.5% over 1928 and from foreign ores 20.4%. Electrolytic Zn amounted to 25% of the total primary output (26.6% in 1928). The recovery of unalloyed secondary Zn (65,400 short tons) decreased 7.5%. World smelter production (1,613,000 short tons) exceeded all previous records and was 3% more than 1928. Montana was the leading producer of metallic Zn (13% less than in 1928), Illinois second (8% increase) and Oklahoma third (5% increase). AHE(16)

PLANTS & LABORATORIES (17)

Ontario Research Foundation, Report for 1930. J. W. FLAVELLE. Published by H. W. Ball, Toronto, 1931, 31 pages.
The Ontario Research Foundation deals with problems in agriculture, veterinary science, textiles, chemistry, including fuels and ceramics, as well as metallurgy, the last being under O. W. Ellis. The metallurgy department completed the installation of equipment and is studying the effect of Ni in bronze, the effect of cold work on metals and alloys, and the reducibility of 6 Ontario iron ores.
Some 60 firms, through the Ontario Metal Industries Research Association, are coöperating with the Foundation. Work for the Association has included heat-treatment, study of hydrogen-welded products, fatigue of steel, sheet steel for enameling, high test cast iron, etc. Four metallurgical articles have been published. Distribution of technical information to inquiries forms an important part of the work. HWG(17)

Steel Mill Electrification. STRICKLAND KNEASS. *Electrical World*, Vol. 97, June 20, 1931, pages 1176–1179.
The new plant of the A. M. Byers Co., near Ambrigde, Pa., has an estimated ultimate capacity of approximately 45,000 tons of wrought iron products per month, made by a recently developed and perfected mechanical process. Practically all of the auxiliary and main machines are electrically-operated. Several units of the equipment are illustrated and briefly described. WHB(17)

The Dresden High-Pressure Heating Plant. (Das Hochdruck-Heizkraftwerk Dresden.) MAX WENGNER. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, May 1931, pages 129–139.
Discusses the plant of the Dresden Gas, Water and Electric Works as to its economic aspects, the choice of steam pressure, steam temperature and kind of fuel used. A description is given of the various buildings and the system under which they operate. Several pictures and diagrams are included. MAB(17)

10,000 Automobile Frames a Day. SIDNEY G. KOON. *Iron Age*, Vol. 125, June 5, 1930, pages 1665–1668, 1728.
Describes plant and equipment of the A. O. Smith Corporation, Milwaukee Wisconsin. Frames are made on automatically synchronized conveyors and coördinated machines. Within $1^1/_2$ hours time the following operations are completed: selecting and straightening steel strip, pickling, forming, attaching side bars, hangers and clips, assembling, riveting parts in complete frame, cleaning, painting and drying. Each piece is 8 seconds behind the next one. Plant is geared to 450 finished frames an hour. VSP(17)

Operating Details of an American Motor-Cylinder Foundry. A. LENZ. *Foundry Trade Journal*, Vol. 44, Apr. 23, 1931, pages 291–293.
Details of the operation of the Chevrolet foundry, Saginaw, Mich. OWE(17)

Illinois Constructs Commodious Materials Testing Laboratory. H. F. MOORE. *Iron Age*, Vol. 125, May 29, 1930, pages 1594–1597.
It is a four-story brick building. Plan is in the form of an H with 2 wings 50 × 187 ft. and a stem 92 × 110 ft. A new Emery-Tatnall 3,000,000 lb. testing machine ranks among the largest in the world. Other testing machines area 600,000 lb. Riehle, a 200,000 lb. Olsen machine, a 230,000 lb. Olsen torsion testing machine and a Turner impact testing machine. Other testing equipment is composed of 21 rotating beams, 3 for testing metals under repeated twisting, 2 for testing sheet metal, etc. VSP(17)

How to Figure Amount of Water Used by Hydraulic Presses. F. G. SCHRANZ & W. L. DELANEY. *Heating, Piping & Air Conditioning*, Vol. 3, February 1931, pages 135–136.
A very brief article relative to the determination of the quantity of water used for supplying hydraulic presses. A concrete example is given to illustrate just how determinations are made for a two pressure system, that is, a high and low pressure system. WAT(17)

Trends in the Design of Steel Mill Power Plants. F. H. DAMIELS. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 57–60.
Scattered steam drives and isolated small boiler plants are being rapidly replaced in the iron and steel industry by electric drives and central power plants. This is effecting great savings in fuel, maintenance, labor and general expenses. The power plants are fired mainly with blast furnace gas, pulverized coal or coke braize serving as a secondary fuel. Coke braize is utilized in separate boilers equipped with traveling grate stokers. Pulverized coal is handled either in the "bin system" or the "unit system." The very rapid development of "unit pulverizers" and their many obvious advantages over a large storage or bin system promises to make the unit system the preferred means of firing large boilers. JN(17)

Production Economy in Iron and Steel Works. Part 1. OTTO CROMBERG. *Iron & Steel Institute, Advance Copy* No. 5, May, 1931, 17 pages.
An example of a detailed time study is given. In many steel mill processes the rate of production is dependent on one particular operation, which is called the "bottleneck." Methods of management are discussed. JLG(17)

Field Laboratory for Outside Plant Studies. R. G. WATLING. *Bell Laboratories Record*, Vol. 9, July 1931, pages 529–534.
General description of the 85 acre extension of the outside plant laboratory and brief mention of research work of electric, ceramic and weather-proofing nature. Ha(17)

Casts Pipe in Eighteen Foot Lengths. PAT DWYER. *Foundry*, Vol. 58. Aug. 1, 1930, pages 104–109.
Describes plant and equipment of the National Cast Iron Pipe Co., Birmingham, Ala. VSP(17)

Casts Pipe Vertically in Sand. PAT DWYER. *Foundry*, Vol. 58, Sept. 1, 1930, pages 104–107.
Describes the general layout of the plant of the National Cast Iron Pipe Co., Birmingham, Ala. VSP(17)

MACHINERY & SUPPLIES (18)

Recent Trends in Individual A. C. Roll Table Drives. R. M. BAYLES (Westinghouse Electric and Mfg. Co.). *Iron & Steel Engineer*, Vol. 8, Mar. 1931, pages 96–97.
A. C. motors for the direct drive of hot bed roll tables are described. WLC(18)

Defects in Design and Tooling of Bearings. C. H. BIERBAUM. *Machine Design*, Vol. 3, Mar. 1931, pages 37–40.
The author points out that not infrequently the shapes of journal bearings are of such complicated construction that deformations take place. Simple, straight lines, no changes of section and the highest possible degree of accuracy are an economical advantage. Surfaces of bearing alloys composed of hard and soft crystals can be finished best by tooling with a sharp diamond cutter taking a depth of a final cut of 0.001 in. or less at a high speed. In this manner, surfaces can be produced that require only a minimum of running-in time. Ha(18)

The Lubrication of Ball and Roller Bearings in the Steel Mill. D. E. BATESOLE. *Iron & Steel Engineer*, Vol. 8, Jan. 1931, pages 8–12.
The author discusses the lubrication problems of various ball and roller bearing applications in the steel industry. WLC(18)

Roll Table Drives. F. E. HARRELL. *Iron & Steel Engineer*, Vol. 8, Mar. 1931, pages 97–100.
Discusses requirements of roll driving motors in relation to weight and spacing of rolls, conditions of heat, water and scale surrounding the table. WLC(18)

Machinery in the Steel Industry of the United States. F. L. ESTEP. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, pages 533–582.
Lists and comments upon mechanical devices in steel mills. HWG(18)

Electrical equipment of the Slabbing and Hot Strip Mills at the Wheeling Steel Corporation's Steubenville Plant. JAMES FARRINGTON & H. A. WINNE. *Iron & Steel Engineer*, Vol. 8, July 1931, pages 324–336.
The authors describe the substation installation and electrical equipment for the operation of 45″ reversing Universal Slabbing Mill and the Continuous Hot Strip Mill of the Wheeling Steel Corporation at Steubenville. Diagrams and photographs illustrate the layout and electrical connections. WLC(18)

Material Handling in Quantity Production Shop. NORMAN H. PREBLE. *Iron Age*, Vol. 127, June 4, 1931, pages 1806–1809, 1856.
Extract of paper presented at the Birmingham semi-annual meeting of the American Society of Mechanical Engineers. Most obvious purpose for installation of handling equipment is to reduce non-productive cost of moving the product as it passes through the plant. Other items of considerable importance are the increase in productive capacity of men and machines, and the decrease in inventory by keeping material constantly on the move. Reduction of damage is of importance. Type of handling equipment may be sub-divided into 2 classes—intermittent operation and continuous operation. Intermittent is the more inexpensive and more generally used. Overhead power driven trolley conveyor is the most flexible type. VSP(18)

Modern Rolling Mills for Light Metals. (Neuzeitliche Walzwerke für Leichtmetalle.) E. PFANN. *Metallwirtschaft*, Vol. 10, May 22, 1931, pages 427–428.
A rolling mill built recently in Germany for an American aluminum company is described in detail. It contains three rolls and has an ingot capacity of 1300 kg. CEM(18)

Brown-Boveri Mercury-Arc Power Rectifiers in Japan. J. J. STUDER. *Brown Boveri Review*, Vol. 18, May 1931, pages 181–182.
Gives reasons for use of the mercury-arc rectifier as most suitable converter for railways (particularly Japan) where traffic is seasonal. They are used in 1500-V plants, as well as in 600-V plants. MAB(18)

BIBLIOGRAPHIES (19)

Patent Literature on Chromium Plating. (Die Verchromung in der Patentliteratur.) R. JUSTH & F. MARKHOFF. *Korrosion und Metallschutz*, Vol. 7, Apr. 1931, pages 73–82.
Includes discussion. An exhaustive collection of patents on chromium plating irrespective of the commercial importance or "possibility of application." The authors accumulated "all patents granted or pending" in the following countries: Germany, Austria, England, U. S. A., France and Switzerland. The subject to which the patents refer is briefly but effectively pointed out and subdivided under the following head-lines: (1) Electrolytes based on chromic acid, (2) electrolytes composed of lower valence compounds of chromium, (3) molten salt electrolysis, (4) deposition of chromium alloys, (5) anodes, (6) anodic pre-treatment, (7) thermal treatment, (8) intermediate layers, (9) various processes, (10) protective layers on the surface of the baths, (11) chromium plating of commercial goods on a large scale, (12) application of chromium plating. EF(19)

Supplementary Bibliography on Effect of Temperature on Properties of Metals. L. F. MCCOMBS (Battelle Memorial Institute). *Preprint* for A. S. T. M.—A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 meeting *American Society for Testing Materials*, pages 567–620.
To supplement 2 previous bibliographies put out by the Joint Research Committee on Effect of "Temperature on Properties of Metals" published in 1928 and earlier in 1931. Articles on properties of metals at high and low temperatures are listed. The period mainly covered is April 1, 1930 to April 1, 1931, but 311 references prior to 1930, not given in former bibliographies, are included. There are a total of 587 references arranged by years and an author index. HWG(19)

MISCELLANEOUS (20)

National Tube Co.'s New Plant for Making Electric Weld Pipe. M. ROSENKRANZ. *The Steel Maker*, Vol. 2, No. 1, 1931, pages 29–30.

A brief description of the Christy Park Works for electric welding of pipes of from 14 to 30 in. in diameter in lengths of 40 ft. Another section makes pipes of from 24 to 72 in. in diameter in 30 ft. lengths. The hammer-weld department makes pipe by gas welding up to 96 in. in diameter. Ha(20)

Permanently Accurate to the Millionth. CHARLES M. POND. *Metal Progress*, Vol. 19, Mar. 1931, pages 70–76.

The author describes and discusses methods of production and checking of very accurate gage blocks. WLC(20)

Ferrous Scrap Handling and Salvaging in the Automotive Industry. R. R. REES. *American Metal Market*, Apr. 14, 1931, pages 8, 10.

Presented at National Management Congress, Cleveland, O., April 1931, of A. S. M. E. DTR(20)

On the Mechanics of the Plastic State of Metals. A. NADAI. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, 1930, *Applied Mechanics*, pages 193–216.

Includes discussion. A study of the mechanical conditions under which plastic flow in metals occurs. Rules relative to the stresses and the deformation when the stresses reach the limit of plasticity are discussed. Some cases of plastic flow with rotational symmetry around an axis in cylinders are considered. As examples, the case of a bar in combined tension and torsion and that of a hollow cylinder subjected to a high internal pressure and axial forces are treated. The cases of pure bending of a bar with a rectangular cross-section and of pure torsion of a bar with a circular cross-section are discussed, assuming a general law of deformation. Also application of this theory is made to the hollow cylinder subjected to internal pressure. Methods of finding the residual stresses after severe plastic deformation are discussed, and the results obtained in the study should throw light on the problem of these stresses. (20)

New Rolled Sections for Welded Cranes. (Neue Walzeisen für geschweisste Krane.) KARL MELCHER. *Die Schmelzschweissung*, Vol. 9, May 1930, pages 120–121.

The present standard sections of strucutral iron were adapted to fit the riveting process for joining them together. For welding processes, different sections would be more suitable and should be developed especially to diminish the work for preparation and welding. A few illustrations are given of such flat and half-cylindrical sections and a calculation shows how the stresses can often be reduced thereby. Ha(20)

Calculations of the Depth of Ferro-Magnetic Ores. (Beräkning av magnetiske malmers djupgaende.) TH. DAHLBLOUR. *Jernkontorets Annaler*, Vol. 115, March 1931, pages 95–102.

One of the poles of an ore magnet appears always to be situated close to the deepest point of the ore body, irrespective of the relation of dip and strike to the magnetic field of the earth. If the position of the lower pole can be determined, the approximate depth of the ore is consequently known. At a sufficient distance from the ore, the magnetic field may be considered to be approximately equal to that of an ideal magnet, and the author describes several methods by which the poles of the ore magnet may be found through measuring the direction of the field at different points on the surface. The best results are obtained by using curves drawn through points where the angle between the direction of the magnetic field and the axis of the magnet has the same value. HCD(20)

On the Attack of Metals by Insects. II. (Ueber den Angriff von Metallen durch Insekten. II.) O. BAUER & O. VOLLENBRUCK. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVIII, 1931, page 1.

See also *Metals & Alloys*, Vol. 2, Feb. 1931, page 46. (20)

Welding by Piece Work. (Akkordschweissen.) H. W. NIESS. *Autogene Metallbearbeitung*, Vol. 23, Dec. 1, 1930, pages 374–376.

Discussion of piece work as compared with time work. In general, piece work is advocated for most cases. Ha(20)

The Utilization of the Blast Furnace Slag in Japan. S. OKA. *The Journal of the Society of Chemical Industry*, Japan, Vol. 34, Feb. 1931, pages 33B–34B.

Reviews article by M. Kahara in January issue of Kōgyō Kwagaku Zasshi. Production of the slag is increasing rapidly. Slag cement and slag mortar products are not promising; production of slag bricks is increasing; blast furnace slag cement and iron Portland cement are best and least expensive products; slag ballast simplest, oldest and largest consumer of slag: slag tar ballasts used as pavement material; slag blocks in trial state, but profitable. MB(20)

On the Heating Rate of Billets. S. UMINO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, pages 583–601.

In Japanese, with a English summary of 2 pages. Mathematical study of the rate of heating of billets of various sizes. HWG(20)

Intercrystalline Cracking in Steam Boilers. F. G. STAUB. *Transactions Second World Power Conference*, Berlin, 1930, Vol. 7, pages 363–366.

General. EAH(20)

Design of Balancing Machine Commands Unusual Attention. E. L. THEARLE. *Machine Design*, Vol. 3, July 1931, pages 39–42.

The principle of this dynamical balancing method is based on the fact that any substantially rigid rotating body can be dynamically balanced correctly by the addition of 2 weights, one in each of 2 arbitrarily chosen transverse planes of the body. For this reason, the balancing machine consists of a hollow case which is attached to the body to be balanced and in which 2 balls are running freely. First the balance is made for one plane, then for the other. The unbalance of the body in rotation is counteracted by the balls moving in their race in such a way as to decrease the unbalance of the system. The position which the balls assume can be read on a scale and the necessary weight determined and the location fixed. The construction of the machine and the operation are described in detail. Ha(20)

Plant Vacuum Cleaning Safeguards Men and Machines. LESTER C. SMITH. *Iron Age*, Vol. 127, June 11, 1931, pages 1892–1895.

A central vacuum cleaning system renders at least 5 distinct services. They are: (1) rapid and thorough cleaning; (2) cleaning return tube and sectional boiler flues and the boiler room; (3) cleaning electrical and power plant equipment; (4) removal of dust at its source; and (5) removal of excess material in manufacturing processes. VSP(20)

The Making of a Carding-Engine Cylinder. B. SIMPSON. *Foundry Trade Journal*, Vol. 45, July 9, 1931, page 28.

Description, accompanied by 4 diagrams, of an economical method of producing a carding-engine cylinder. OWE(20)

75 Years of Steam Boiler Operation. (75 Jahre Dampfkesselwesen.) FRIEDRICH SCHULTE. *Archiv für Wärmewirtschaft und Dampfkesselwesen* Vol. 12, June 1931, pages 162–167.

Jubilee meeting of the Verein deutscher Ingenieure presents papers and discussion on the development of different kinds of boiler construction, the cylinder boiler, the fire-tube boiler, the fire-tube flue boiler, ship boilers, drumhead and vertical tube boilers. Overheating, preheating, storage tanks, furnaces, preparation of feed-water, boiler operation and supervision are also considered. The activities of the V. D. I. and the Dampfkessel-Überwachungs-Vereine are reviewed. MAB(20)

Things We Learn in the Laboratory. L. C. PAN. *Monthly Review American Electroplaters' Society*, Vol. 18, May 1931, pages 29–31.

A brief outline of the course for foremen in electroplating in the College of the City of New York. Ha(20)

Markets for Gases Electrolyzed with Off-Peak Power. PAUL MCMICHAEL. *Electrical World*, Vol. 97, June 20, 1931, pages 1182–1185.

Outlets for oxygen are well established and new markets for hydrogen make electrolysis of water economically feasible. Present and possible uses of O_2 and H_2 are mentioned. Tables show: (1) economical voltage for cell operation under various conditions, (2) electrolytic cell plant, capacity equivalent to 10,000 kw. a. c., and (3) availability of off-peak energy in the plant analyzed. Serious consideration may now be given to the use of electrolytic cells in the place of liquefaction equipment for the production of O_2 only. "Because of the great flexibility of operation possible with electrolytic cells and the fact that air liquefaction apparatus must be operated continuously if O_2 is to be made at a reasonable cost, the advantages of electrolytic cells with power only intermittently available are apparent." WHB(20)

Accident Prevention in the Autogenous Field. (Unfallverhütung auf dem Autogengebiete.) W. KEMSIES. *Die Schmelzschweissung*, Vol. 10, May 1931, pages 124–126.

Inexperience and carelessness cause about 90% of the accidents. It is important to make this evident to the personnel and to elucidate the special points which may give rise to dangerous conditions. A series of accidents are described and the manner in which they might have been prevented by carefulness is explained. Ha(20)

Fire Prevention on Aircraft. (Erhöhung der Sicherheit von Luftfahrzeugen durch Bekämpfung der Brandegefahr.) F. KÜHN. *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Apr. 14, 28, 1931, pages 197–206, 241–244; translated as *Technical Memorandum* No. 628, *National Advisory Committee for Aeronautics*, July 1931, 23 pages.

Seamless flexible metal tubes are easily broken by the continual vibration. Other types of flexible piping show promise. All fuel and oil pipes should be double, one pipe within another. No soldering of pipes should be permitted, as it makes the pipes brittle. Long pipes should have flexible connections. Sheet electron should not be used for engine cowling. If the thin magnesium alloy sheet starts to burn, various types of fire extinguishers are ineffective. The balance of the article relates to other than metallurgical problems. HWG(20)

The Systemization of Die Design Departments. O. B. JONES. *Metal Stampings*, Vol. 4, Jan. 1931, pages 45–46.

The value of the drafting department to the manufacturing plant should be appreciated. The draftsman and the shop man should coöperate in all new ideas with sympathy and understanding. The author deplores the periodic see-sawing of supremacy between die designing department and die maker observed in the sheet metal departments of several automobile plants. Is this perpetual shifting of authority necessary? JN(20)

The Use of Heat and Power in the Breweries. (Wärme- und Kraftverbrauch in Brauereien.) J. SCHLEMENSON. *Archiv für Warmewirtschaft und Dampfkesselwesen*, Vol. 12, June 1931, pages 169–173.

Investigation of the average-sized steam brewery: brewing process, carrying out of the investigation, the results of the tests on the steam boiler, on the steam engine, and on the rest of the machinery are described; the normal amount of heat used for 1 hectolitre of beer, the power consumed, and an evaluation of the heat balance and suggestions are given; the investigation of a small brewery with a direct heat copper is considered with reference to operating methods, testing of the steam boiler and the copper, and the heat consumed. A summary is made. MAB(20)

The Effect of Stirring on the Rate of Coagulation of Gold Sol. EMLYN JONES. *Transactions of the Faraday Society*, Vol. 27, Feb. 1931, pages 51–58.

Employing an apparatus which ensures more controllable conditions of stirring than those obtained by previous investigators the effect of agitating the sol, when in process of coagulation by various concentrations of electrolyte, is investigated. The results obtained are very complex. When the concentration of the electrolyte is such as to ensure conditions of rapid coagulation, stirring produces a decided accelerating influence. Such an accelerating effect is attributed not simply to the increase in collision frequency between the particles of the sol, but likewise to the aeration or formation of air bubbles in the sol. The conditions existing in such aeration are likely to be favorable to aggregation. When the concentration of the electrolyte is such as to give rise to slow coagulation of the gold sol, stirring is found to have a retarding or inhibitive effect on the coagulation. This may be accounted for by a disruption or displacement of the "imperfect" or incomplete outer layer of the double layer, giving rise to temporary but effective increase of charge and, therefore, to a decrease in coagulation velocity. The work was carried out in the Department of Physical Chemistry in the University of Liverpool. WAT(20)

Rapid Calculation of Bearing Loads Can Be Made with Simplified Forms. I. and II. ROBERT N. JANEWAY. *Automotive Industries*, Vol. 64, May 30, 1931, pages 831–838; June 6, 1931, pages 875–879.

Tremendous time-saving in determining pressures is made possible by using simple arithmetic processes with charts shown. The first requisite for simplifying the calculation is the reduction in the number of points at which the resultant force must be obtained during the cycle. The proposed method resolves all forces into vertical and horizontal components and uses the true mean values of each component over any given interval to obtain the mean resultant force for the interval. WHB(20)

Metallurgical Laboratory at Twelfth Aviation Exposition. (Le laboratoire de métallurgie du XIIe salon de l'aviation. 28 Novembre-14 Décembre 1930.) JEAN GALIBOURG. *Revue de Métallurgie*, Vol. 28, June 1931, pages 330–347.

One of the characteristic features of this exhibition is the presentation of the contemporary developments of the metallurgy and the applied sciences. In the present exhibition the work of the different scientific committees and societies was presented together with the demonstration of metallurgical processes made during the recent years. A detailed description of the activities of this section of the exposition is given. JDG(20)

Destruction of Metals by Insects. (Metallzerstörungen durch Insekten.) DR. FREITAG. *Oberflächentechnik*, Vol. 7, Oct. 7, 1930, pages 184–185.

Recent tests have shown conclusively that certain insects can really destroy metals. Two beetles, especially, (dermestes peruvianus and dermestes lardarius) destroy materials of lead. In 4 hrs., they could bore through a plate 0.2 mm. thick. The same was shown to be true in the case of tin; but brass, zinc and aluminum were proof against destruction in this manner. The destruction is by biting and is purely mechanical. See also "On the Attack of Metals by Insects," *Metals & Alloys*, Vol. 2, Feb. 1931, page 46. Ha(20)

Sucker Rods, A. P. I. Specifications. C. N. BOWERS & B. B. WESCOTT. *Petroleum Engineer*, Vol. 2, May 1931, pages 81, 84, 86, 89, 93, 96, 98.

Reasons for standardization of equipment, and the A. P. I. sucker rod specifications. (20)

Cylinder Wear and Its Cure. C. E. BAXTER. *Motor Transport*, England, Vol. 52, Apr. 27, 1931, pages 473–474.

Cylinder wear or the matter of piston fit has become important and so it is fortunately possible to incorporate into existing engines, without much cost and trouble, the latest advances which have been made in this direction. As time goes on harder cylinders or liners will add further advantages. Modern science is providing the necessary solution, both in the way of alloys and finishing methods. WHB(20)

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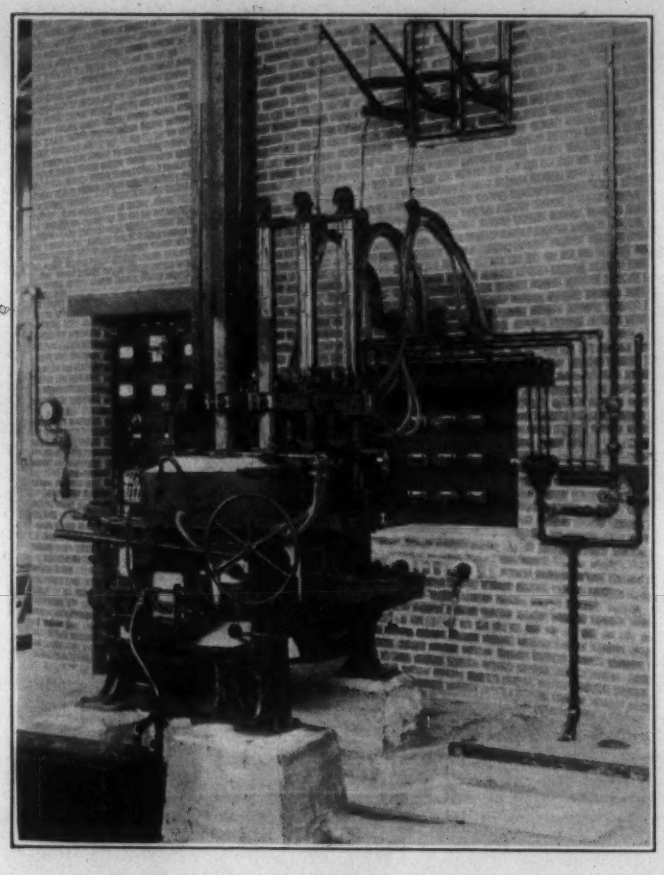

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FOUNDRY PRACTICE & APPLIANCES (22)

Correlation of Mechanical Tests Involves Many Difficulties. J. G. Pearce. *Foundry*, Vol. 58, Oct. 15, 1930, pages 62–65, 70; Nov. 1, 1930, pages 93–97.

Exchange paper of the British Foundrymen and presented before the American Foundrymen's Association, Cleveland. Explains some of the reasons for the variations in the factors governing the production of cast Fe. Simple procedures underlying investigations on cast Fe are: (1) effect of variations in composition on properties of cast Fe may be studied by testing bars of same size, but with variations of composition; (2) effect of variations in rate of cooling on properties may be studied by testing bars of different sizes; (3) effect of variations in melting conditions may be studied by testing bars of the same size and composition under varying melting conditions. Part 2 discussed the effect of varying melting conditions, change of strength with section and composition and interpretation of deflection figure in transverse test. VSP(22)

Overcome Alloy Ingot Trouble. W. E. Paulson. *Foundry*, Vol. 58, Aug. 15, 1930, page 60.

Describes difficulties encountered in producing non-ferrous castings using alloy ingots. From results obtained author concludes that virgin metals or their equivalent are absolutely essential for production of best quality castings. See *Metals & Alloys*, Vol. 2, Apr. 1931, page 87. VSP(22)

Briquetting of Cast Iron Borings and Steel Turnings. A. K. Nowak (Baldwin-Southwark Corp.). *American Metal Market*, Vol. 38, Apr. 21, 1931, pages 11–12.

Presented at A. S. M. E. 2nd National Industrial Congress, Cleveland, O., April 1931. Losses due to oxidation and slagging off during remelting of scrap cast iron borings and steel turnings are high. Briquetting practically eliminates losses. Material compressed to reduce proportion of surface to weight and thus bring oxidation effect on compressed blocks to minimum. Two commercial machines described. In tests of melting briquettes in the cupola, no difference noted in physical and chemical properties of produced metal. No change in % of good castings and scrap, using as high as 21% briquettes in the charge. DTR(22)

The Production of High-Test Cast Iron. Richard Moldenke. *Iron & Steel of Canada*, Vol. 14, Jan. 1931, pages 1–19; Feb. 1931, pages 27–28, 41–42.

After reviewing the character of high-test cast iron, particularly the manner in which the graphite present in this material is distributed, Moldenke refers to methods of arriving at the desired structures. The next part of the paper is taken up with a discussion of what had been done prior to the discovery of the basic principles involved in the rational production of this material. A very complete description of the cupola process is included in this article, and its disadvantages are discussed. The second part of this article deals with the methods adopted in the manufacture of high-test cast iron. Electric furnace process and its products are compared with the fuel-fired furnace and its products. Details of the electric furnace process are very fully discussed. OWE(22)

Cupola Melting of Bronze. E. R. Darby. *Metal Industry*, New York, Vol. 29, Mar. 1931, pages 111–112.

From *Metals & Alloys*, Nov. 1930, pages 812–813. A description is given of a shaft type furnace for high speed melting of bronze. The furnace holds 500 lbs. of metal and melts 2500 lbs. of metal per hour. The success of this furnace depends on the use of a newly developed pitch coke of exceptionally high purity. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 83. PRK(22)

The Constant-Air-Weight Method of Cupola Blowing. Part I. H. V. Crawford (General Electric Co.). *Iron and Steel Engineer*, Vol. 7, Dec. 1930, pages 559-565.

The author describes his method of supplying air to the cupola by weight, operation of the cupola, and the electrical equipment for automatic control of the weighed air supply. WLC(22)

Cupola Melting of High Test Cast Iron. F. B. Coyle (International Nickel Co.). *Metal Progress*, Vol. 19, Feb. 1931, pages 47–50.

Abstract of a paper to be presented before the Western Metal Congress, San Francisco, Feb. 16, 1931, and to be published in full with discussion in the Transactions. The constitution of gray iron is analyzed as an aggregate of steel and graphite and 3 factors affect its strength, (1) amount, size and distribution of the graphite, (2) amount of cementite and (3) amount of alloy in the steel-like matrix. By proper control of these factors gray iron of varying degree of superior strength can be obtained up to 50,000 lb./in.^{2} Graphite particles must be small and uniformly distributed, the total carbon must be low. To attain this without oxidation high percentages of steel scrap in the charge and careful operation of the cupola are essential. Details of charge and the cupola operation are described. The properties, composition, and applications of such high strength gray irons are reported and discussed. WLC(22)

Cast Iron. Report of A. S. T. M. Committee A-3, H. Bornstein, Chairman. *Preprint* No. 11 for June 1931 Meeting, *American Society for Testing Materials*. 3 pages.

Progress report of committee and sub-committee. HWG(22)

Practical Cupola Control. (Misure pratiche per il controllo dei cubilots.) G. Conti. *La Metallurgia Italiana*, Vol. 23, May 1931, pages 390–399, 13 references.

Discusses measurement of blast, analysis of combustion gases, and pyrometry of gas and of molten metal. Most of the discussion is based on articles by Carra and Fric (*Chaleur et Industrie*, Dec. 1927 and Jan. 1928) and by Wensel and Roeser (*Foundry Trade Journal* 39, 1928, page 245, *Trans. A. F. A.*, Vol. 36, 1928, page 191). Temperatures in a few cupola runs are plotted. HWG(22)

Electric Process Iron for Cylinder and Cylinder-Head Castings. H. E. Bromer (Standard Foundry Company.) *American Metal Market*, Vol. 38, May 12, 1931, pages 11–12.

Paper presented at Annual Convention American Foundrymens' Association, Chicago, May 1931. Gives duplexing and continuous cold-melting processes, showing ease of control of carbon and silicon, uniformity in chemical analysis, hardness of cylinder blocks and physical properties. Gives electric furnace iron alloys and properties. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. DTR(22)

The Effect of Excessive Atmospheric Moisture in Cupola Blast. Neil A. Moore. *Foundry Trade Journal*, Vol. 44, May 28, 1931, pages 375–376, 378.

Paper presented to the Chicago Convention of the American Foundrymen's Association. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. OWE(22)

The Life of Malleable Cast Iron. *Foundry Trade Journal*, Vol. 44, May 28, 1931, page 374.

Abstract of article by E. K. Widin and N. G. Girschowitsch (*Die Giesserei*, 1930, No. 47) on the fluidity of malleable cast iron. The method adopted by these authors involved the use of a molded spiral. The factors, coal dust content, water content, and strength of molding sand, were investigated in this connection as were also the height of the gate, and the dimensions of the gate and of the casting. OWE(22)

The Conditions of Absorption and Oxidation in Small Cupola Furnaces at the Melting of Steel Scrap. (Zu-und Abbrandverhältnisse beim Einschmelzen von Stahlschrott im kleinen Kupolofen.) E. PIWOWARSKY, H. LANGEBECK & H. NIPPER. *Die Giesserei*, Vol. 17, Mar. 7, 1930, pages 225–230; Mar. 21, 1931, pages 275–280; Apr. 11, 1931, pages 352–360.

An experimental plant and some tests to determine the influence of the most important operating factors are described. The furnace had 300 mm. diameter. Briefly, the results are: (1) the amount of air supplied per minute has practically no influence on the carburization of the scrap but sulphur increases with increasing air velocity and quantity and the reduction of Si and Mg increases somewhat with increasing amount of air; (2) the carburization depends to a certain extent on the amount of coke per charge, an increase of the latter increases also the carburization zone and sulphur increases in the same ratio; (3) additions of normal slag did not show any influence on the carburization but it favored the absorption of sulphur and the burning of Si and Mg; (4) the operation of the furnace was investigated for melting with continuous iron flow, melting with discharges from time to time and melting at reduced height and amount of coke with continuous iron flow. Carburization is highest for the first method and lowest for the third. No influence could be stated for sulphur. The burning of Mg and Si was least for the second. The more scrap, the higher was the carburization and sulphurization but the lower the burning of Mg and Si. All experiments were described in detail. Ha(22)

Electric-Furnace Cast-Iron. H. E. BROMER. *S. A. E. Journal*, Vol. 29, July 1931, pages 85–89.

Melting in the electric furnace is the only means by which gray iron can be produced in quantities under absolute control, according to the author. Good iron can be produced from a cupola, but the cupola cannot be depended upon to produce uniformly good iron. Expensive alloys, which have been used to improve the quality of the cupola iron for cylinder-blocks, can be eliminated by the electric-furnace method. Results of tests of iron from regular electric-furnace production are charted and tabulated and comparisons are made with products of the cupola in the matter of Brinell hardness. Micrographs of the electric-furnace and cupola iron are given for comparison, and the significance of the difference in their structure is explained. Electric-furnace iron is said to be desirable for brake-drums, fly wheels and piston rings, as well as many other parts besides the cylinders and cylinder-heads which are considered more particularly in this paper. A great development in this method of melting during the next few years is predicted. The discussion brings out the importance of Brinell readings or some other method of measuring hardness of cast iron. Hardness and wearing qualities are said to be much influenced by the handling which the casting receives in the mold. Superheating iron and pouring it at high temperatures contribute to uniformity of structure and minimize internal strain. Cost of iron melted first in the cupola and finished in an electric furnace is said to be approximately the same as that of cupola iron. Scrap iron can be used in the electric furnace, without the addition of pig, because the sulphur content is not increased in the process. One discusser reports at length observations gathered during a tour in which many of the leading automotive foundries were visited. Ha+WAT(22)

The Brackelsberg Process for the Production of Grey Iron. P. BARDENHEUER. *Foundry Trade Journal*, Vol. 44, Apr. 23, 1931, pages 287–290.

A very complete description of the Brackelsberg process, including details of melting costs and of experiments in which charges of various types were employed. The article is accompanied by 9 photographs, 2 diagrams, and 3 tables. OWE(22)

The Laboratory and the Foundry. R. ARZENS. *Foundry Trade Journal*, Vol. 44, June 18, 1931, pages 413–414.

A brief paper dealing with the contribution which the laboratory can make to foundry practice. Reference is made to the improvement of the quality of the raw materials entering the foundry, of the finished products leaving the foundry, and of melting practice, as well as to laboratory and shop equipment essential for success in laboratory control. OWE(22)

Compact Foundry Handling System. SIDNEY G. KOON. *Iron Age*, Vol. 125, Apr. 10, 1930, pages 1069–1072, 1124.

Describes a combination of a vertical loop handling sand and a horizontal loop handling for molds and castings system of the General Electric Co., Pittsfield, Mass. Equipment was made by the Chain Belt Co. VSP(22)

Some Observations on the Preparation and Use of Synthetic Sand. L. B. KNIGHT. *Foundry Trade Journal*, Vol. 44, May 28, 1931, pages 367–368.

Paper read before the Chicago convention of the American Foundrymen's Association. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. OWE(22)

Teaching Pattern Design at the University of Illinois. B. RUPERT HALL. *Foundry Trade Journal*, Vol. 44, May 28, 1931, page 365.

A brief article, accompanied by one photograph, dealing with the course in pattern design which is given at the University of Illinois, in which the work is carried on entirely in the drafting room, using free-hand sketching and mechanical drawing. Hall states that it has been found possible for engineering students to get by this method of instruction from four to five times the amount of technical knowledge acquired by the making of actual patterns in the laboratory. OWE(22)

Gating Iron Castings. E. M. Handley. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, page 242.

Discusses the value of gating to the jobbing shop and deals with two things which must be known about any job before calculating the gating area—namely, the metal thickness and the weight. Dietert's formulas for calculating the effect of sprue height and the area of the choke are given. Reference is also made to pouring temperatures. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. OWE(22)

Making a Large External Part of a Friction Clutch in Dry Sand. A. GREENHALGH. *Foundry Trade Journal*, Vol. 44, Apr. 9, 1931, pages 263, 265.

Description of the manufacture of a friction clutch 72 in. in diameter and weighing approximately $3^1/_2$ tons. OWE(22)

An Italian Sand-Preparing Plant. J. CUNNINGHAM. *Foundry Trade Journal*, Vol. 44, June 25, 1931, pages 432, 440.

Describes sand-cleaning and sand-mixing machines manufactured by the Stabilimenti Tema, of Turin. The article is illustrated by 2 photographs and 1 diagram. The plant comprises a used-sand hopper; a new-sand hopper; rotating, feeding and proportioning plate; a bucket elevator; continuous sand-cleaning machine; and continuous tempering and mixing mill. OWE(22)

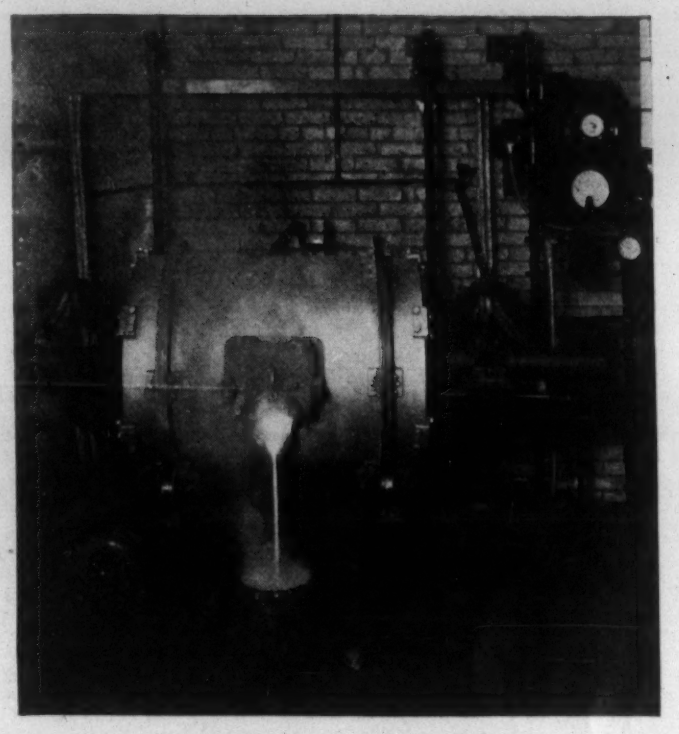
The Desulphurizing and Refining of Grey Cast Iron with Soda Ash. E. W. COLBECK & N. L. EVANS. *Foundry Trade Journal*, Vol. 44, Apr. 30, 1931, pages 305–307.

An article, accompanied by 4 photomicrographs and 5 tables, dealing with results of experiments on the use of soda ash. OWE(22)

The Fundamentals of Brass Foundry Practice, Part 26. R. R. CLARKE. *Metal Industry*, N. Y., Vol. 29, July 1931, pages 302–303.

Nickel additions harden and strengthen copper alloys. Molds for copper alloys high in nickel require highly refractory sand faced with plumbago; also large feeding gates and risers. For nickel silver the sand should be dry and the metal hot. Aluminum and magnesium are common deoxidizers, but silicon is used with 50–50 copper nickel alloys intended for electrical purposes. PRK(22)

DETROIT Rocking Electric FURNACES



Small (250 lb.) Detroit Electric Furnace Pouring Heat of Alloy Steel

These furnaces manufactured in capacities from 250 lbs. per hour to 6000 lbs. per hour, offer unusual economy in the production of grey iron, malleable iron, alloy steel, or non-ferrous castings showing the highest possible quality. The rocking action of the

DETROIT ELECTRIC FURNACE

insures complete homogeneity and uniformity, as well as physical characteristics of a highly superior character in the finished castings. Over 50 DETROIT ELECTRIC FURNACES are in use in melting or duplexing grey iron or alloy steel, and over 400 furnaces are in use in the non-ferrous foundries throughout the world.

We will be pleased to send you complete information regarding these remarkable furnaces.

DETROIT ELECTRIC FURNACE COMPANY

827 West Elizabeth St.

DETROIT MICHIGAN

Testing of a Cupola Furnace. (Onderzoek naar de werking van een koepeloven.) T. W. SIERTSEMA. *De Gieterij*, Vol. 5, Apr. 1931, pages 44–47.

Graphs are presented which give as a function of the time from the beginning of the operations: (1) the weight of each charge, (2) the temperature of the charge, (3) the statistical wind pressure and (4) the volume of air in m^3. The curves show plainly the importance of a continuous melting process without interruption of the wind pressure. The general results agreed satisfactorily with those given by Piwowarsky in his book on high test cast iron. HSvK(22)

Cupola High-Test and Alloy Irons in a Machine Tool and Gray Iron Jobbing Foundry. L. M. SHERWIN & T. F. KILEY. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, July 1931, pages 115–160; *Foundry Trade Journal*, Vol. 45, Aug. 13, 1931, pages 102–104.

See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. CHL + OWE(22)

Cupola Malleable Cast Iron. H. H. SHEPHERD. *Iron & Steel Industry & British Foundryman*, Vol. 4, Feb. 1931, pages 151–152; Mar. 1931, pages 199–200; Apr. 1931, pages 251–252; May 1931, pages 281–282.

While it is not claimed that malleable cast iron possesses as good physical properties as air furnace iron, it readily adapts itself to continuous foundry operation; it is less costly and it tends to be more sound and free from shrinks. Statements regarding the types of pattern, core and mold equipment required, the properties of core and molding sands and the composition requirements of the metal are made. CHL(22)

Measuring Temperatures of Molten Metal in the Brass Foundry. H. H. ST. JOHN. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, May 1931, pages 35–44.

Author presents a discussion on the need for controlling pouring temperatures of non-ferrous metals. Types of pyrometers available are described together with precautions to be taken in their maintenance and use. CHL(22)

Patternmaking and Its Relationship to Design and Foundry Practice. M. RUSSELL. *Foundry Trade Journal*, Vol. 44, Apr. 9, 1931, pages 253–256.

Paper, with discussion, dealing with patternmaking. Special attention is paid to the competition with welded structures, now being encountered by foundrymen, and means are suggested whereby it may be met. The paper is accompanied by 13 diagrams. OWE(22)

The Gating and Pouring of Castings. E. V. RONCERAY. *Foundry Trade Journal*, Vol. 44, May 28, 1931, pages 369–371.

Deals with the factors affecting shrinkage, the principal types of gating, and the three essential considerations in pouring—temperature, speed, and evacuation of gas from the mold. The paper is accompanied by 2 photographs and 5 sketches. OWE(22)

Factors Which Influence the Surface Quality of Gray Iron Castings. W. G. REICHERT & D. WOOLLEY. *Transactions & Bulletin Amercan Foundrymen's Association*, Vol. 2, Aug. 1931, pages 205–234.

See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. CHL(22)

The Relationship Between the Engineering and the Foundry Trades. L. H. POMEROY. *Foundry Trade Journal*, Vol. 45, July 9, 1931, pages 25–27.

A paper read before the Birmingham Convention of the Institute of British Foundrymen, in which the application of cast iron to the automobile trade is largely the basis of discussion. The author refers to early work on cast iron and to more recent work on the production of non-ferrous castings. Some attention is directed to the question of wear and to the problem of materials required to resist pressures of the order of 1,000 lb./in.^{2} Criticism of certain research work is made, and the necessity of considering stiffness in connection with engineering design, rather than mere tensile strength, is discussed. Some attention is directed to the economics of the foundry industry and comparison made between methods of working in the United States and Great Britain. OWE(22)

Recent Developments in Cast Iron Foundry Practice in Great Britain. J. G. PEARCE. *Metallurgia*, Vol. 4, June 1931, pages 55–60.

From a paper presented at the annual conference of the Institute of British Foundrymen. Describes work of British Cast Iron Research Association. JLG(22)

Mechanizing a Giant Foundry. J. B. NEALEY. *Scientific American*, Vol. 145, 1931, pages 44–45.

Bringing the variables under closer and closer control is an ever-present problem in foundry technique. New ideas and equipment with this purpose in view are being constantly devised and put into use. This modernization of foundry practice has been carried on at two foundries of the Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin, to a remarkable degree. This company manufactures gas engines, steam engines, turbines, condensers, air and gas compressors, tractors, mining machinery, and many other large unit machines, as well as special work. Castings as large as 125 tons are made of a single pouring. Metal is furnished by six cupolas. All pouring is direct from cupola to flask with crane service, and ladles of $1^1/_2$ to 30 tons capacity. Hand, machine, pit and loam molding are all employed. One of the most noticeable features is the absence of smoke and dirt in the air. Carefully prepared sand is elevated by bucket conveyor to hoppers which drop it onto belt conveyors which take it to points just over the core makers where it drops by gravity and through chutes directly into core boxes on molding machines. The feed is started and an automatic device shuts off the flow when the correct amount has been furnished. One of the unique pieces of equipment in this foundry is an especially designed washer where the cores and sand are forced out of the casting hydraulically and at the same time the castings are cleaned. Four pictures show the general arrangements. WAT(22)

Pattern-Making. (Der Modelbau.) RICHARD LÖWER. Julius Springer, Berlin, 1931. Cloth, $6^1/_2 \times 9^1/_4$, 229 pages. Price 17.50 RM.

This description of the making of wood patterns is so profusely illustrated that it will be useful even to those who have little German.

The writer recognizes that there are two distinct problems in making patterns and core boxes, depending on whether they are for permanent use, or whether only a very few castings are to be made. Correct and erroneous methods of woodworking and of construction of patterns are shown by sketches.

Diagrams of hundreds of types of patterns are shown for different methods of molding. Any pattern maker can find much that will be helpful in the volume, but it will be difficult for him to locate it, since there is no index and the table of contents is not very detailed.—H. W. Gillett (22)-B-

Some Developments in Modern Foundry Practice. E. LONGDEN. *Foundry Trade Journal*, Vol. 44, Apr. 9, 1931, pages 259–262; Apr. 16, 1931, pages 277–280.

Discusses various processes for the production of high-test cast iron—namely, the Lanz, the Emmel and Meehanite. Considerable space is given to the discussion of melting furnaces, including the Poumay cupola, the balanced-blast cupola patented by the British Cast Iron Research Association, and the Brackelsberg rotary furnace. Some attention is directed to mechanical cupola-charging plant, to sands and refractories, and to core- and mold-drying plant. Special mention is made of the molding of a 20-ton hydraulic cylinder casting. The article concludes with a description of a continuous casting plant and with brief notes on core-making, sand-casting machines, and the dressing of castings. The article is accompanied by 15 photographs and 3 diagrams. OWE(22)

FURNACES & FUELS (23)

Loss of Heat and Life of Roof of Open-Hearth Furnaces. ALBERT SCHÜSTER. *Iron Age*, Vol. 127, June 18, 1931, pages 1976–1978.

Translated from article in *Stahl und Eisen*. Gives results of study of factors influencing life of open-hearth roof, based on temperature measurements at various points in the roof at occasional intervals. Roof heat losses rise about threefold from the beginning to the end of measurements, in relation to total heat consumption of furnace—from 3.21 to 8.5%. Proportion of roof loss to heat consumption of hearth increases from 8.89 to 22.6%. Depth of penetration of heat into brick is proportional to the thickness of the brick. Resistance of roof to attack of slag, lime or dust is of great importance. Danger of burning off depends on flow of gases and their control and not on thickness of bricks. VSP(23)

Gas Producers for Continuous Operation. (Gaserzeugungsöfen für stetigen Betrieb.) A. SANDER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, June 13, 1931, pages 746–750.

The development of the continuously operated chamber furnaces have made it possible to simplify and cheapen the cost of gas production. A few modern types are described and compared with regard to their performance. Four references. Ha(23)

Slagging of Hot Surfaces. (Verschlackung von Heizflachen.) P. ROSIN. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Mar. 1931, pages 81–83.

Paper presented at Düsseldorf, Jan. 7, 1931. Discusses the formation of slag deposits and the means for removing them. Outlines the test methods for determining the behavior of ash when striking against hot surfaces. MAB(23)

Furnaces for High Temperatures. (Oefen für hohe Temperaturen.) ST. REINER. *Chemische Fabrik*, Mar. 19, 1930, pages 85–86.

Places emphasis upon the heat conductivity of the refractory material and outlines the construction of a furnace used for temperatures as high as 2200° C. EF(23)

Self Regulating Induction Furnace with a Ferromagnetic Muffle. (Four à induction á moufle ferromagnetique autoregulateur de temperature.) R. PERRIN & V. SORREL. *Journal du Four Electrique*, Vol. 40, May 1931, pages 168–169.

A muffle furnace is proposed consisting of a ferromagnetic muffle surrounded by an envelope made of a ferromagnetic substance which becomes non-magnetic at the maximum operating temperature of the furnace. The combination is properly heat insulated and placed into an induction coil of copper wire fed with an A.C. line of the usual frequency. Induction currents raise the temperature of the envelope and the muffle itself until the temperature is reached at which the envelop becomes non-magnetic. The coil is so adjusted that the amount of heat developed by induction in the muffle alone is sufficient for taking care of the heat losses thereby keeping the furnace at a constant temperature. Ferro-cobalt and ferro-nickel alloys are a suitable material for the muffle and its lining. The temperature reached is but little affected by the changes in amperage, and with a moderately uniform current will remain practically stationary. The furnace used had a cylindrical muffle 150 mm. diameter, 350 mm. long and 12 mm. wall thickness made of 30% Fe-Co. The liner was made of 3 mm. Ni sheet and the coil consisted of the three layers of copper strip 10 by 3 mm. Using a 50 cycle current and varying its amperage from 40 to 120 amperes the temperature of the furnace was kept between 946 and 972°. The range of alloy steels available at the present would permit the making of these furnaces to cover temperatures from 15° to 1100°. JDG(23)

Tests on and Conversion of an Oil-Fired Annealing Furnace. (Untersuchung und Umbau eines Glühofens mit Masutheizung.) I. M. RAFALOVITSCH. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, May 1931, pages 141–144.

Description of a newly established method for equalization and optional regulation of the temperature of an oil-fired heating furnace. MAB(23)

Heat Exchange in Regenerators. (Der Wärmeaustausch in Regeneratoren.) EM. LUBOJATZKY. *Metall und Erz*, Vol. 8, May 1931, pages 205–214.

Contains 12 references. A theoretical discussion covering the development of the physical laws of heat exchange, calculation of the heat exchange number for convection and conduction, calculation of heating surface in heating chambers, heat currents and heat endurance in regenerators and the influence of gas radiation on heat exchange. CEM(23)

Steel Furnace Repairs. WALTER LISTER. *Metallurgia*, Vol. 4, July 1931, pages 97–99.

Detailed directions for repairing both basic and acid open-hearth furnaces. In keeping the bottom in repair it is essential to rabble out all steel before making new bottom. Electric furnace repairs are also mentioned. JLG(23)

On Blast Furnace Coke and Fire Bricks for the Iron and Steel Industries of Japan. T. KURODA. *Proceedings World Engineering Congress*, Tokyo, 1921, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 133–161.

Coking practice and analyses of coals and cokes, and the methods of making refractories in Japan are given. HWG(23)

Heat Required by a Lacquer Furnace. (Wärmebedarf von Lackieröfen.) W. NÖTTING. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, June 1931, pages 175–178.

Presents the basis for calculation of the heat required for a lacquer furnace and also the conversion of a charcoal furnace into a gas furnace. MAB(23)

High Frequency Steel Furnaces. D. F. CAMPBELL. *Rolling Mill Journal*, Vol. 5, Jan. 1931, page 64.

Paper presented before the British Iron and Steel Institute. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 16. JN(23)

The Large Electric Furnace Plant of the Adlerwerke. (Die elektrische Gross-Ofenanlage der Adlerwerke.) U. ASCHMANN. *Elektrotechnische Zeitschrift*, Vol. 52, June 18, 1931, page 823.

Cementing, refining and hardening furnaces of small parts for automobiles, typewriters and bicycles are described. Eight furnace chambers in double and single units of 100 KW 220 volts/unit are installed. Ha(23)

A Small Stationary Furnace for Aluminum Melting. ROBERT J. ANDERSON. *Industrial Gas*, Vol. 9, Mar. 1931, pages 15–17; *Brass World*, Vol. 27, May 1931, pages 104–106.

Description of the construction of a reverberatory furnace of 2000 lb. fired by natural gas. The temperature can be raised from room temperature to 760° C. in 30 minutes. It takes about 2 hrs. to melt 2000 lbs. of aluminum. Ha+WHB(23)

Furnaces for High Temperatures. (Oefen für hohe Temperaturen.) J. D'ANS. *Chemische Fabrik*, Feb. 5, 1930, pages 41–43.

Gas-fired filled with magnesium oxide. Crucible made of zirconium oxide. Reaches 2200° C. in about 45 minutes. EF(23)

Coke Oven Operation and Maintenance. F. J. PFLUKE. *American Gas Journal*, Vol. 134, Jan. 1931, pages 50–53.

Describes maintenance of the instruments, proper draft setting, a simple apparatus for pyrometer checking, the measurement of the flue temperature, determination and use of cooling curves, regenerator inspection, oven and flue pressure balance, and the reversing mechanism. MAB(23)

Automatic Regulation of Arc Furnaces (Le reglage automatique des fours á arc). GABRIEL DURAND. *Journal du Four Electrique*, Vol. 40, May 1931, pages 171–174.

After some theoretical consideration on the efficiency of arc furnaces a simple and effective electrode regulator is described. Their control is achieved, at present, by individual and rather powerful motors supplied with many fixtures for prevention of the effects of non-uniform action. The hydraulic regulator proposed requires a single motor running all the time at full capacity and activating a pump feeding the cylinders, the pistons of which are connected by the proper means with the electrodes. A relay closes or opens the orifice controlling the flow of water for any given cylinder. A very accurate and effective control is possible with this device. JDG(23)

Heat Treating Furnaces. FRED GROVE-PALMER. *Metal Industry*, London, Vol. 38, May 22, 1931, pages 521–522, 526.

A general description of some modern all-electric furnaces and auxiliaries is given. PRK(23)

Electric Melting Pots Have Been Simplified. P. H. CLARK. *Electrical Manufacturing*, Vol. 7, June 1931, pages 48–50.

The author is in the industrial heating engineering department of the General Electric Company. Immersion electric heating units have made melting pots both simple in construction and efficient in operation. Thus the electric melting pot has become a more practicable production tool because first cost is reduced, special pots are easier to produce, upkeep is greatly reduced, and first costs are considerably lowered. The pictures of various types of units are shown. WAT(23)

Industrial Furnaces for Gas. I. Metal Pot Furnaces for Soft Metal Melting. II. Crucible Furnaces. III. Special Furnaces for Metal Melting and Reduction. LAWRENCE E. BIEMILLER. *American Gas Journal*, Vol. 134, Feb. 1931, pages 34–36; Mar. 1931, pages 36–39; Apr. 1931, pages 46–48.

I. The metals melted in a metal pot furnace are lead, tin, babbitt, zinc, solder, type metal, white metal alloys and aluminum. They all melt well under 1000° F. The advantages of the tilting type furnace are given. II. Considers furnaces with crucibles, mainly graphite crucibles. They operate at higher temperatures than metal pot furnaces. They are used for melting brass, copper, gold, nickel, Monel, etc., as well as precious metals. It is desirable to use a tilting type furnace. Describes the most recent development in brass melting, the Rotary Brass Melter developed by the American Gas Furnace Company and the American Gas Association. The casting of brass and other metals is often desirably accomplished with a ladle or insulated crucible. III. Considers special furnaces used in the printing industry, for metal coating such as galvanizing, and for metal reduction. MAB(23)

Heating-Element Deterioration Reduced in Cyanide Furnace. R. E. JAMES & GLENN COLEY. *Electric World*, Vol. 97, June 6, 1931, pages 1057–1058.

Field observations and laboratory experiments indicate that: (1) cyanide or its components have a deleterious effect upon Cr-Ni alloys; (2) the reaction between cyanide and Cr-Ni alloys increases rapidly with an increase in temperature and approximately 1650° F. is the maximum safe temperature for economical operation; (3) it is not economically practical to exclude cyanide or its components from the element chamber; and (4) the deterioration of Cr-Ni heating elements heated in air is exceedingly slow (at temperatures below 1800–2000° F.). From these conclusions, the deterioration of the heating elements is explained. An experimental furnace of air circulation type was designed and built by the research laboratory of the Detroit Edison Co. and placed in the plant of the Gemmer Mfg. Co. for a life and production test. The input of the test pot was 43 kw. and after 1800 work-hours' service, the input was 42.5 kw. No scale was found around the elements but traces of leakage were evident and a heavy deposit, apparently cyanites, was found on the floor of the entire chamber. Electric and physical examination showed no deterioration of the elements. There was a lack of appreciable quantities of the black smudge which usually forms on the surface of molten cyanide. It is believed that this smudge is a cyanite caused by the oxidation of the cyanides and is suppressed by the lower temperature differential and uniform heating of this type of pot. The new pot is shown in elevation and section and is described. WHB(23)

The Coreless Induction Furnace in the Steel Industry. E. F. NORTHRUP. *Iron & Steel Engineer*, Vol. 8, May 1931, pages 210–215.

A paper presented at the A. I. & S. E. E. Electric Heating & Welding Conference, Pittsburgh, Pa., Jan. 21, 1931. Inductive electric heating is more versatile in application than other electric methods of heating. It is superior to any other known method for the direct conversion of electric energy into useful heat. Several typical and representative installations are briefly discussed. The lines of commercial development of coreless inductive heating are listed as: (1) more and larger ferrous metal melting furnaces, gradually displacing the arc furnace melting; (2) heating to forging temperature of symmetrically shaped metal bodies in increasing quantities and the maintaining of temperature in hot steel billets as pushed from the molds and replacing the soaking pit; (3) heating to an annealing temperature stacked piles of thin sheet steel; (4) heating for annealing purposes or normalizing continuously moving metal strip and rod; (5) heating with temperature control and great uniformity very large muffle annealing furnaces; (6) extension of inductive heating with small furnaces supplied with very high frequency power for all varieties of scientific investigation where freedom from contamination of the charge is essential and where the temperatures that may be reached will meet all scientific requirements; (7) the production on a large scale of very high temperature heaters for such purposes as the graphitization of coke; (8) the construction and use of multiple ton furnace-ladles which will maintain the metal at a constant temperature and electrically stir this metal to any desired degree for refining it under slags. WHB(23)

Heating in Liquid Baths. R. L. ROLF. *Houghton's Black & White*, Vol. 3, Jan. 1931, pages 10–15.

The advantages of the salt bath as a non-scaling, non-oxidizing medium for uniform heating are discussed. The selection of a proper salt or combination of salts permits a wide range of temperatures from 300° to 1200° F. Salts should be completely water soluble so that the work will come out bright and clean from the quench. It is good practice, especially for pieces with greatly varying sections, to pre-heat the pieces before introduction into the bath to avoid cracks from the sudden temperature change. Ha(23)

A Thermal Study of an Open-Hearth Furnace. W. M. HENRY (American Steel & Wire Company) & T. J. MCLOUGHLIN (Carnegie Steel Company). *Preprint* for May 1931 meeting *American Iron & Steel Institute*, 39 pages.

Very detailed study of heat balance, pressure, draft, temperature, and volumetric relations in a 60 ton basic open hearth. The test required the services of 21 men. Data are given in 14 tables. Steel of 0.07% C, 0.36% Mn, 0.03% S, 0.01% P was made. About 7½ million B.t.u./ton were supplied as fuel and in preheating air. Nearly 3 million B.t.u./ton were discharged through the stack. Much air infiltration was met. It is suggested that the use of fans to supply the required air might lead to economies. The authors comment on the lack of standardization in methods of presenting heat balances. HWG(23)

REFRACTORIES & FURNACE MATERIALS (24)

Refractory Materials. COLIN PRESSWOOD. *Metallurgia*, Vol. 3, Apr. 1931, pages 223–225.

A discussion of laboratory methods for testing refractories. JLG(24)

Comparison of Insulating Materials for Industrial Furnaces and Boilers. (Vergleich von Wärmeschutzstoffen für industrielle Oefen und Kessel.) VICTOR PASCHKIS. *Archiv für wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Jan. 1931, pages 9–11.

Choice of insulating materials for furnaces, boilers, etc., can be somewhat simplified by approximation formulae. They are based upon derivation from known figures for the limiting case of the plate. Approximate known figures for practical purposes are given. MAB(24)

Refractory Materials for Electric Furnaces. III. Nickel and Its Alloys, Including Nickel-Chromium Alloys and Nickel-Silver. ALFRED B. SEARLE. *Metal Industry*, London, Vol. 38, June 5, 1931, pages 569–571.

The properties of many refractories are listed. Among the chief requirements for bricks for use in electric furnaces used to melt nickel are: refractoriness should not be less than that of Seger cone 32 (1700° C.), should be resistant to very sudden changes in temperature, should be poor conductors of electricity, etc. Roofs of furnaces are made of silica brick or even carborundum and alundum. Care must be exercised in the use of heat insulating brick which may cause too high a temperature of lining. PRK(24)

A Study of Magnesia Refractories. (Recherches sur les produits refractaires magnesiens.) LONGCHAMBON & KO-FUH-TSIANG. *Revue de Métallurgie*, Vol. 28, June 1931, pages 324–329.

Experiments were conducted using plant practice but starting with pure materials to determine the conditions of sintering magnesia, agglomeration of the sinter into bricks, the influence of the natural and intentionally added impurities and the changes produced by burning of brick. The density increases up to 1800° burning and then decreases. It is considerably affected by the presence of foreign elements. Addition of Al_2O_3 decreases the refractoriness of MgO bricks. Fe_2O_3 is an excellent binder at low temperatures but very rapidly reduces the softening point; even small amounts of CaO reduce cohesion very strongly so that bricks cannot be made; SiO_2 produces solid agglomerates but affects too much the softening point which is even more affected by the mixture of SiO_2 and CaO; a mixture of Fe_2O_3 with CaO is excellent as an agglomerant. The temperature of burning has a pronounced effect on the softening point which is higher the higher is the former. Pure magnesia with caustic magnesia binder after burning at 2000° was still serviceable at 1900°. JDG(24)

GASES IN METALS (25)

Gas Removal and Grain Refinement of Aluminium Alloys. W. ROSENHAIN, J. D. GROGAN & T. H. SCHOFIELD. *Engineering*, Vol. 130, Sept. 12, 1930, pages 340–341; *Foundry Trade Journal*, Vol. 43, Sept. 11, 1930, pages 177–180.

Abstract of paper read before the Institute of Metals, Sept. 10, 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. LFM+VSP(25)

The Determination of Oxygen and Nitrogen in Irons and Steels by the Vacuum-Fusion Method. H. C. VACHER & LOUIS JORDAN. *Bureau of Standards Journal of Research*, Vol. 7, Research Paper No. 348, Aug. 1931, pages 375–401.

Apparatus and procedure for the determination of H, O and N in ferrous materials by the vacuum-fusion method are described in detail. The results of a number of analyses of ferrous materials are discussed. The data indicate that the method (in the absence of interferences) gives values reproducible to within 0.002% for either O or N. The data also indicate that the accuracy of the O determination is affected only when the steel contains a relatively large amount of alumina and Mn or when the fusion is made in a crucible which already contains a residue in which Mn is present. No similar influences have been encountered, which would affect the accuracy of the N determination. The oxides commonly encountered in ferrous materials, with the exception of alumina, are probably completely decomposed shortly after the sample has melted. The time of decomposition, when the sample does not contain relatively large amounts of alumina, is approximately 5 min. If the decomposition should require a longer time, the harmful effect of Mn is increasingly evident. Mn affects an O determination when it is simultaneously present as vapor with carbon monoxide immediately above the crucible. Such a condition results in the formation of a non-volatile compound, presumably manganese oxide, which deposits in the cooler parts of the furnace and, consequently, is not determinable with the present apparatus. The effect of Mn vapor has been detected from residues containing as little as 0.2% Mn. Therefore, it is recommended that analysis be made in crucibles free from Mn. A relatively slow decomposition of oxides in the presence of Mn vapor is considered to be the most serious source of error so far identified in the O determination. WAT(25)

The Absorption of Nitrogen by Steel. R. S. DEAN. *U. S. Bureau of Mines Report of Investigations* 3076, Mar. 1931, 8 pages.

The effect of N on the quality of steel is reviewed. Evidence is given that the solid solubility of N in pure iron is below 0.005% and its absorption is indicated to be due to impurities, particularly Si. It is concluded that the known effects of N in steel are such that the steel-maker will very soon be called upon to control the N content of at least part of his metal. At present there is no proved method of doing this. AHE(25)

INSPECTION (26)

The Fracture of Quenched Specimens as a Quality Test in Tool Steel. (Hardbrottsundersökning sasom kvalitetsprovningsmetod för verktygstal.) RARNAR ARPI. *Jernkontorets Annaler*, Vol. 115, Feb. 1931, pages 75–94, 42 references.

The object of the investigation was to ascertain if the fracture of specimens quenched from different temperatures gives a reliable indication of the quality of the steel. The specimens were compared with a scale of 10 fracture classes, where 0 designates a very coarse-grained fracture and 10 the finest fracture obtainable. Experiments have been carried out on different materials at several Swedish steel works. The method is very simple, and it is not difficult to classify the fractures, but on the other hand the method has not been found to be entirely reliable. While steels with a wide quenching range (fine grained fracture at widely differing quenching temperatures) also show good results when practically tested as tools, a narrow quenching range may not necessarily mean inferior quality. HCD(26)

Testing for Acceptance or Service. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 19, Apr. 1931, pages 87–88.

Further notes on safety in aircraft parts. WLC(26)

Methods Employed in the Testing of Cast Iron Pipe. W. C. CONARD. *Water Works Engineering*, Vol. 83, Jan. 1, 1930, page 28.

General description of the various tests to which cast iron pipes are subjected for inspection. GN+WHB(26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Manganese and Sulphur in Mild Steel. BERNARD THOMAS. *Iron & Steel Industry & British Foundryman*, Vol. 4, May 1931, pages 259–260.

Limits in the S and Mn contents of mild steel for welding and forging purposes are expressed graphically. For welding, they are 0.065% S with 0.70% Mn; for forging they are 0.10% S with 1.40% Mn. CHL(27)

Effect of Adding Bismuth to Cast Iron. E. K. SMITH & H. C. AUFDERHAAR. *Iron Age*, Vol. 128, July 9, 1931, pages 96–100.

Gives results of research conducted by the authors. Cites literature on Bi. In general, the effect of Bi on cast Fe is as a softener; strength is lowered as is the Brinell hardness number. Bi treated bar may be drilled more easily than untreated bars. Additions of Bi to most cast Fe results in softening effect coupled with breaking up of carbides. This is due to deoxidation of cast Fe. Results of the effect of Bi on malleable Fe and steel were inconclusive, due to the fact that Bi boiled at a lower temperature than malleable Fe and steel. VSP(27)

Statistical Research of the Analyses of Pig Iron. (Grosszahl-Forschungen an Roheisen-Analysen.) K. DAEVES. *Stahl und Eisen*, Vol. 51, Feb. 12, 1931, pages 202–204.

During three months, the analyses of 3 blast furnaces producing Thomas pig iron were used to plot curves of frequency for every individual element. A comparison with the analyses of the subsequent iron mixer shows the equalizing effect upon the variations of the analyses. The relations between silicon, manganese, phosphorus and sulphur were established in curves. GN(27)

Investigations on the Effect of Oxygen and Sulphur on Forgeability, Red Shortness and Other Properties of Pure Iron. (Untersuchungen über de Einfluss von Sauerstoff und Schwefel auf die Schmiedbarkeit, Rotbrüchigkeit und andere Eigenschaften des reinen Eisens.) E. W. FELL. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, pages 386–387.

This is an abstract of the original paper by the author in *Archiv für Eisenhüttenwesen*, Vol. 4, Feb. 1931, pages 393–400, as abstracted in *Metals & Alloys*, Vol. 2, Aug. 1931, page 153. GN(27)

Effect of Aluminum on the Wearing Qualities of Steel. (Einfluss des Aluminiums auf den Verscheiss von Stahlen.) R. COLLEE. *Metallbörse*, Vol. 21, Jan. 31, 1931, page 199.

The manufacturers of fire arms found that abnormal wear of the steel sometimes occurred. An exhaustive investigation of all factors was made and it was found that abnormal wear was associated with relatively high aluminum oxide content. The following method was employed to determine the aluminum oxide content: The steel was dissolved in hydrochloric acid which dissolved everything but the silicic acid and the aluminum oxide. When fusing with sodium carbonate, the alumina was converted into soluble sodium carbonate which was converted into aluminum chloride by dissolving in hydrochloric acid. The silicic acid was obtained as a residue. Sodium phosphate was added to the filtrate to form aluminum phosphate which is insoluble in acetic acid whereas iron phosphate dissolves. When adding sodium hypophosphate and sodium acetate, the iron salts are reduced completely to the hyposulphate, and aluminum is precipitated as aluminum phosphate. WHB(27)

Silicon as an Alloying Element. J. ARNOTT. *Metal Industry*, London, Vol. 38, June 12, 1931, pages 597–598; June 19, 1931, pages 616, 620; *Foundry Trade Journal*, Vol. 44, June 11, 1931, pages 397–398.

Paper presented before Institute of British Foundrymen, June 9–12, 1931. Includes discussion. Brief mention is made of iron-silicon and aluminum-silicon alloys. Silicon-bronze (Cu 94: Si 4: Zn 2) is a substitute for gun-metal. The addition of 2.8% Si to Monel metal gives an alloy hardenable by heat treatment—softened at 980° C. and hardened at 590° C. PRK+OWE(27)

Arsenic in Soft Steel. (Arsen in Flusstahl.) O. BAUER. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 231–245, 17 figs.

See *Metals & Alloys*, Vol. 2, Apr. 1931, page 89. HWG(27)

The Advantages of Titanium Additions to Aluminum. (Ueber die Vorteile von Titanzusätzen zu Aluminium.) H. RÖHRIG. *Aluminium, Hauszeitschrift der V. A. W. Erftwerk*, Vol. 3, Jan.–Mar. 1931, pages 32–39.

See *Metals & Alloys*, Vol. 2, Aug. 1931, page 153. Ha(27)

On the Metal Constituents in the Bright Gold. I. On the Heat Resisting Metals. II. On the Fastening Metal Bi. III. On the Other Metals Except Bi and Rh. AKIRA NAKATSUCHI. *Journal Society of Chemical Industry*, Japan, Vol. 34, May 1931, pages 164B–166B.

The author has an opinion that heat-resisting metals probably serve as protective colloids for gold. Gold showed no heat-resisting power at temperatures above 500° C.; there was much grain growth. The latter could be suppressed even at 768° C., Rh having the greatest preventive action.

Part 2. Bi is added as a flux; Au is dispersed in a colloidal form into the melted mixture of glaze and Bi_2O_3; if Rh is present, grain growth is prevented and the metal film is fastened on the ware completely with brilliancy.

Part 3. The addition of Cr, Al, Fe and Ru prevents grain growth in gold, and makes a brilliant golden film attainable in burning. Cr may probably serve to prevent grain growth up to 650°, Rh being used for higher temperatures. MAB(27)

The Influence of Molybdenum and Titanium on the Properties of Gray Cast Iron. (Ein Beitrag zur Frage des Einflusses von Molybdän und Titan auf die Eigenschaften von Grauguss.) J. H. KÜSTER & C. PFANNENSCHMIDT. *Die Giesserei*, Vol. 18, Jan. 16, 1931, pages 53–58.

The influence of Mo (0.5–2.5%) and Ti (0.05–0.2%) on the mechanical and structural properties of gray cast Fe is investigated. With increasing Mo addition to gray cast Fe the tensile, the continuous impact and the bending strengths and the Brinell hardness of the Fe increases. Metallographic tests show that Mo tends to promote the carbide formation. The cast Fe samples alloyed with Ti in every case show an increased resistance to wear. With increase in the Ti addition the tensile and bending strength of the cast Fe increases. Micrographs (16) are shown. (27)

The Influence of Nickel on the Temperature of the Metastable and Stable A_1 Conversion of Eutectic Iron-Carbon and Iron-Carbon-Silicon Alloys. A Contribution to the Question of the Graphite Eutectoid. (Der Einfluss von Nickel auf die Temperaturen der metastablien und stabilen A_1-Umwandlung eutektischer Eisen-Kohlenstoff- und Eisen-Kohlenstoff-Silizium-Legierungen. Ein Beitrag zur Frage des Graphiteutektoids.) A. MERZ & F. FLEISCHER. *Die Giesserei*, Vol. 17, Aug. 22, 1930, pages 817–825.

The dependence of the conversion temperature on the velocity of the test is linear. For each 1% Ni, the metastable conversion temperatures are reduced by 12° C. Si increases the temperature slightly but becomes more pronounced for more than 2% Ni. The hysteresis increases with increasing contents of Ni and Si. After proper heat treatment in order to obtain the stable state, the investigations showed a linear increase of the A_1 conversion temperatures of 31° C. for each 1% Si and linear reduction of 12% for each 1% Ni. The existence of a graphite eutectoid is affirmed. Test curves and micrographs are given; and 14 references cited. Ha(27)

INSTRUMENTS & CONTROLLERS (28)

New "Standard" Temperatures. (Neue temperaturfixpunkte.) OTTO REDLICH & GUSTAV LÖFFLER. *Zeitschrift für Elektrochemie und angewandte physikalische Chemie*, Vol. 36, Sept. 1930, pages 716–722.

The new method of measuring temperatures by means of the platinum resistance thermometer and Kohlrausch-Jaeger differential method of overlapping shunts is discussed. The transformation points of the solid phases $NaNO_3$, $Na_2SO_4.10H_2O$ (Glauber's salt), $NaNO_3$, Na_2SO_4, H_2O (Darapscite) and Na_2SO_4, $Na_2SO_4.10H_2O$, NaCl are given as 13.154° C. and 17.878° C respectively, the former with a mean error of 0.0011° C., the latter with a mean error of 0.0022° C. The eutectic temperature for the potassium chloride-ice system is given as −10.646° C. with a mean error of 0.0025° C. OWE(28)

Magnetization and Magnetic Aging of Permanent Magnets for Electrical Measuring Instruments. (Magnetisierung und magnetische Alterung von Dauermagneten.) E. SCHRAMKOW & B. JANOWSKY. *Zeitschrift für technische Physik*, Vol. 11, Oct. 1930, pages 361–363.

Problems involved in the utilization of permanent magnets for measuring instruments. (28)

Study on Thermostat. III. Research on Time Lag of Various Thermometers. SHUU KAMBARA & MOTOTARO MATSUI. *Journal Society of Chemical Industry*, Japan, Vol. 34, May 1931, pages 167B–172B.

Explanation of time lag and previous method of determination, the principle of the new method of determining lag, the apparatus and experimental procedure, observations and results, and a summarizing statement and table constitute the treatment of the subject. MAB(28)

Examination of Zeiss' Large Metallurgical Microscope. (Prövning af Zeiss' stora metallmicroskop.) C. BENEDICKS & P. SEDERHOLM. *Jernkontorets Annaler*, Vol. 115, June 1931, pages 302–309.

The stability of the instrument was found excellent, a shaking through a 10° angle producing only 0.001 mm. displacement of the field. The fine adjustment is slightly too gross, for a magnification of 1500, but a further refinement in the set screw enables a magnification of 3000 to be precisely attained. A sector diaphragm constructed by one of the authors was found to be superior to the eccentric diaphragm for oblique illumination provided with the instrument. HCD(28)

Optical Activity and High Temperature Measurements. F. M. JAEGER. McGraw-Hill Book Company, Inc., New York, 1930. Cloth, 6 × 9¼ inches, 450 pages, 137 figures. Price $4.00.

This book is essentially a reprint of the lectures delivered by Professor F. M. Jaeger of the University of Gröningen, at Cornell University, during the second semester of 1928–29, under the George Fisher Baker Non-Resident Lectureship in Chemistry.

It is the custom to introduce these annual lectures by a lecture devoted to some topic of general interest which in this case is a discussion of the present and future state of our natural resources. A brief account is given of the energetic and material resources of nature, the former being represented by the natural stores of energy that can be utilized directly for the production of mechanical force, and the latter being represented by minerals and metals. There are three series of lectures. The first is concerned with spatial arrangements of atomic systems and optical activity; the second with the methods, results and problems of precise measurement at high temperature; and the third with the constitution and structure of ultramarine. For the most part the investigations preceding the lectures were carried out by Professor Jaeger and his co-workers in the chemical laboratory of the University of Gröningen.

The first series give a general discussion of our more recently acquired views on the relations between geometrical and physico-chemical properties of atomic systems occurring in inorganic and organic molecules. After a brief review of the discovery of the facts summed up in Pasteur's Law, the author illustrates how the principle of symmetry can be utilized in problems dealing with the possibility of separating optically inactive substances into their enantiomorphous antipodes. The historical role of Le Bel Van't Hoff is emphasized. Theoretical views are given on the chemical structure of complex inorganic salts and the basis on which our ideas of their spatial arrangement is founded. The possibility of effecting a totally asymmetrical photosynthesis is discussed with emphasis on the significance of this problem in the synthetic processes of nature.

The second series first takes up the principles and problems involved in high temperature measurements up to 1650° C. which is of extreme importance in the ceramic, glass and metallurgical industries. After discussing the development and refinements of the measuring methods at high temperatures and some of their applications the author says on page 249, "It would be interesting, at this date, to reinvestigate a number of phenomena of binary and ternary metallic systems, applying the modern improved methods. This might develop many new and surprising facts and phase-transitions which so far have escaped observation by the cruder methods heretofore employed. Such work might prove to be of the greatest importance for the metallurgical industries also." The methods and equipment for the accurate determination of the temperature coefficient of the surface tension of liquids between −80° and +1625° C. is especially interesting. The methods, equipment and results at high temperatures are given for specific gravity and viscosity determinations, the measurement of the electrical conductivity of molten salts which is especially difficult above 700° C. and the measurement of the internal friction of molten salts. On the important topic of the precise measurement of the specific heat of solids up to 1650° C. many practical points are discussed and considerable data is included.

The third series is a discussion of the constitution and structure of ultramarine and gives the results of investigations recently carried out at the University of Gröningen.

The contents of this book should prove of inspirational and material value to students of physics and chemistry at large and the second series of lectures should be of particular interest to those metallurgists who are interested in fundamental research. The author's easy style, versatility, natural familiarity with the work which he has directed and inclusion of many data tables made the book valuable for general information and reference.—

Oscar O. Miller(28)-B-

Measurement of Surface Temperatures. (Mätning av yttemperaturer.) ARVID JOHANNSEN. *Jernkontorets Annaler*, Vol. 115, May 1931, pages 278–281.

The apparatus consists of a box-like arrangement with the open edge fitting the contour of the surface to be measured. A mercury thermometer is placed alongside the hot surface and pressed against it by asbestos or cotton packing held in the box. Temperature equilibrium is attained in about 20–30 minutes. On an iron surface the arrangement may be held in place by a magnet. HCD(28)

Taking Industry's Temperature. D. C. LAMB. *Scovill Standard*, Vol. 4, May-June 1931, pages 8–9.

Some of the methods and instruments for temperature measurements are outlined briefly. Ha(28)

How to Make Thermo-Elements of Thin Wires. (Herstellung von Thermo-elementen aus dünnen Drähten.) O. KANTOROWICS & R. REINECHE. *Zeitschrift für technische Physik*, Vol. 12, Dec. 1930, page 547.

Hot junction of 0.02 mm. wires were cold welded by using goldfoil. EF(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Experience with Stay-bolts and Fire-box Copper in England and Germany. (Erfahrungen mit Stehbolzen- und Feuerbuchskupfer in England und Deutschland). R. KÜHNEL. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 1–11.

Includes discussion. The results on corrosive effects lead to 3 conclusions: (1) the influence of temperatures above 400° C. is greater than that of changes in gas atmosphere, CO_2, CO or O_2; (2) the influence of HCl and SO_2 is greater than changes in gas atmosphere and exceeds it at 400° with 0.1% HCl 65 fold, 0.1% SO_2 is $^1/_3$ as effective as an equal amount of HCl; (3) water from leaks catalyzes the corrosion. EF+RFM(29)

Effect of Low Temperatures on Metals and Alloys. H. W. RUSSELL. *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Metals, June 1931 meeting *American Society for Testing Materials*, pages 486–506.

Low temperature properties are important in refrigerating engineering, in railways and in aircraft. Refrigerating agents that may be used in testing are listed, and low temperature thermometry discussed. Data on mechanical and physical properties at low temperatures of metals and alloys are tabulated. Tensile strength and hardness increase. Impact resistance usually decreases. Brittleness, on notched specimens, is the main low temperature trouble. Unnotched samples are less likely to be brittle. Aluminum and its alloys do not become very brittle but most ferritic steels do. Nickel steels, especially those with high nickel, are quite free from brittleness. Hitherto unpublished work on endurance at −40° F. is reported on Monel, plain Cr stainless, 18–8, $3^1/_2$% Ni steel and Cr Mo steel. All endurance limits were higher than at room temperature, approximately following the increase in tensile strength. All retained good notch toughness even at lower temperatures save the plain Cr stainless (0.07% C, 13.85% Cr). Cast iron is not appreciably injured at low temperatures, even brittleness not being greatly increased. Failures are more likely due to stresses arising from temperature changes than from poorer properties of the cast iron itself. Elastic properties, thermal expansion, heat capacities, thermal conductivity, electrical conductivity and other physical properties are discussed. In general increases are found in all properties save toughness (elongation, reduction of area, impact resistance) and in compressibility, thermal expansion and specific heat, which decrease. HWG(29)

Apparatus for Low-Temperature Endurance Testing. H. W. RUSSELL & W. A. WELCKER, JR. Appendix III to Report of Joint Research Committee on Effect of Temperature on the Properties, *Preprint* No. 29, June 1931 meeting, *American Society for Testing Materials*, 7 pages.

Describes method for making endurance tests at −40° C. on an R. R. Moore endurance machine by boxing in specimen and bearings and cooling with solid CO_2. Automatic temperature control is described and temperature uniformity of specimen is discussed. Kerosene is a good lubricant for the endurance machine at −40° C. Methods for low temperature tensile, Brinell and impact testing are briefly discussed. Low temperature endurance and other data obtained with the apparatus described are included in another paper by Russell at the same meeting. It costs about $2.00 per million cycles, operating at the 1750 r.p.m. for solid CO_2 to cool the endurance apparatus to −40° C. Hence a single test run to 50 million cycles costs $100.00 for refrigerant alone. HWG(29)

Endurance and Other Properties at Low Temperature of Some Alloys for Aircraft Use. H. W. RUSSELL & W. A. WELCKER, JR. *Technical Note* No. 381, *National Advisory Committee for Aeronautics*, June 1931, 13 pages.

Streamline wire fails by corrosion-fatigue in aircraft service. Corrosion resistant materials like 18–8 are far better under corrosion fatigue than ordinary steel. Their properties at low temperatures, however, have to be considered for aircraft service. Low temperature endurance, tensile, impact and hardness data were therefore obtained. 18–8 in annealed and hard-drawn condition, Monel, 12% Cr stainless, as well as a $3^1/_2$% Ni steel and a Cr Mo steel were studied. The last two have not been suggested for streamline wire, but find other wide use in aircraft. An R. R. Moore endurance machine was enclosed so that bearings and specimen were cooled to −40° C. by "dry ice," with automatic temperature control. Details of the apparatus are given. Tensile and endurance tests were made at −40° C., impact and hardness at several temperatures, down to about −80° C. Tensile strength, hardness and endurance limit all increased at −40° C. Except in annealed 18–8, ductility was only slightly affected, usually increasing, but notched-bar impact strength fell off. However, only one alloy, the plain Cr stainless, became really brittle at low temperatures, that one becoming extremely brittle at −40° C. or below, the others remaining decidedly tough at −60° C. or below. HWG(29)

Alloys of Iron, Manganese and Carbon. Part 1. Preparation of Alloys. FRANCIS M. WALTERS. **Part 2. Thermal Analysis of the Binary Alloys.** F. M. WALTERS & CYRIL WELLS. **Part 3. X-Ray Study of the Binary Alloys.** M. GENSAMER, JOHN F. ECKEL & F. M. WALTERS. **Part 4. A Dilatometric Study of the Binary Alloys.** F. M. WALTERS & M. GENSAMER. *Preprint American Society for Steel Treating*, Sept. 1931, 45 pages.

The materials used in the preparation of the alloys were distilled Mn and electrolytic Fe melted in a vacuo. The alloys were melted in an induction furnace under argon at atmospheric pressure, because of the high vapor pressure of manganese. Commercial argon was purified by passing over red-hot metallic calcium and cooper oxide, and through absorbents for water and CO_2 The melts were allowed to freeze in the furnace. The crucibles were c. p. magnesium oxide and were fired in an induction furnace. The melts, if not overheated, lost little Mn. Over twenty melts with C 0.02% or less have been made for 0 to 100% Mn, and about 20 more have been made with various percentages of C up to 1.65%. A gradient furnace with certain novel features was used for the thermal analysis of high purity, Fe-Mn alloys containing from 0 to 60% Mn. In general, the results agree with those of previous investigators. The low temperature transformations, however, were found definitely in 13 to 20% Mn alloys on both heating and cooling, and it was established by thermal analysis that the α to γ transformation in the 13% alloy takes place about 600° C. (1110° F.). The dilatometer constructed for the study of the Fe-Mn alloys can be used from −200 to +1000° C. with the specimen in a vacuum or an inert gas. The indications of phase changes observed by thermal analysis have been confirmed and extended. The low temperature transformations on cooling of the alloys with 13% or more Mn may be ascribed to the epsilon phase. X-ray measurements of lattice dimensions are used in the interpretation of the dilatometric observations. A preliminary study of the rate of heating and cooling indicates that the rate makes little difference in the temperature at which the transformation begins, but has a marked effect in the transformation range. WAT(29)

Study of the Diffusion of Carbon Monoxide through Steel in the Neighborhood of 800° and 1000°. I (Première contribution a l'étude de la diffusion de l'oxyde de carbone a travers l'acier aux environs de 800° et de 1000°). CLAUDE DECROLY. *Chimie & Industrie*, Vol. 25, Special Number, Mar. 1931, pages 484–489.

Experiments carried out using a slight modification of Thorburn's technic for the determination of CO showed that, at atmospheric pressure, CO does not diffuse through a steel tube 3.5 mm. thick at 800° nor at 1000° C. WHB(29)

The Thermal Conductivity of Cast Iron Between 0 and 100 Degrees Centigrade. H. THYSSEN, J. R. MARECHAL & P. LENAERTS. *Foundry Trade Journal*, Vol. 44, June 11, 1931, pages 405–407.

The authors after passing in review the theoretical principles of heat transmission describe a modified Despretz method of determining relative conductivities. A series of commercial cast irons were tested, using bars of increasing diameters. The main features are that conductivity is higher with increasing phosphorus content and with diminishing diameters of bars. It is also postulated that the size of the graphite lamellae is proportionate to the diameter of the bars. A commercial inference is drawn in connection with the phosphorus content of economizer castings, while pointers are given for the choice of cast iron of high conductivity for industrial applications. The apparatus used is described in detail, mathematical equations set forth the theoretical principles, and the results are illustrated by curves and graphs. WAT+OWE(29)

Creep of Metals. H. J. TAPSELL. Oxford University Press, New York, 1931. Cloth, $6^1/_4 \times 10$ inches, 285 pages. Price $12.00.

Only a man with much experience in the high temperature testing of metals, and with a judicial temperament, could have written this book. It is one that needed to be written, and written the way Tapsell has done it.

He has patiently and impartially studied the work of all the investigators in this line, with detailed attention to their test methods, and put the results all together. He has not cast aside the early work, done with relatively crude methods, but takes from it such facts as it clearly proves, while declining to accept conclusions not warranted by the accuracy of the data upon which they are based. He gives as much credence to the results of careful work by others as he does to his own, a rare quality in an author.

The chapter headings are: short time high temperature tests; general effects of overstrain and creep; characteristics of normal creep curves; short-time creep test methods; long-time creep test methods; the limiting creep stress; creep limits from short-time creep tests; stress limits based on a specified total creep within a given period; stress limits for absence of creep; modifying influences on creep; creep in relation to some other mechanical properties; creep properties of ferrous materials; creep properties of non-ferrous materials; design stresses.

Tapsell says "There can be no doubt that long-time creep tests at present offer the only reliable means of determining the true creep characteristics of materials under service conditions. A prior knowledge of the long-time creep properties of a particular material or class of materials appears essential to the development of a shortened creep test method."

The survey of testing apparatus and methods for determining high temperature properties, the collection of data from many sources, so annotated that its probable reliability is evident, and the engineering discussion of how the data may be applied to design will be of real value to metallurgists and engineers concerned with metals for high temperature use.—
H. W. Gillett(29)-B-

New Metallurgical Research and Its Relation to Shipbuilding. (Neuere metallurgische Forschungen und ihre Beziehungen zum Schiffbau.) A. POMP. *Stahl und Eisen*, Vol. 51, Mar. 19, 1931, pages 368–369.

An article by S. L. Archbutt, in *Transactions of the Institute of Marine Engineers*, Vol. 42, 1930, pages 295–346, is reviewed. This article deals in particular with the hot tensile strength of the steels used in shipbuilding. GN(29)

Corrosion and Other Problems in the Use of Metals at High Temperatures in the Chemical Industries. F. H. RHODES. *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 meeting *American Society for Testing Materials*, pages 42–50.

In distinction from many other high temperature uses for metals, the majority of chemical uses are at such low temperatures that creep is of no importance and corrosion resistance is the main need. A few higher temperature uses are discussed. Retorts for reburning bone char in sugar refineries may operate at 1470° F. Cast iron warps and oxidizes. Steel of 0.75–1% C, 22–25% Cr stands up. Heat exchangers in contact H_2SO_4 plants are made of cold drawn seamless carbon steel tubing, but they corrode if the gas is not dry. Cr steel is better but expensive. Coolers for raw burner gas are of cast iron at the hot end, lead at the cool end. There is attack at the junction, with no satisfactory solution for the problem. Attack by HCl is a problem. Fe-Ni-Mo alloys resist at low temperatures but are attacked at high, and do not have suitable properties for high pressure autoclaves. Embrittlement of steel occurs in evaporators for concentrating NaOH. Fusion pots for caustic operating at 1100° F. are of cast iron. A stronger, less brittle material is needed. Better materials are needed for phenol pots. Steel tube stills for coal tar at 400–500° F. are attacked. Cast iron resists better and is used for the part in that temperature range. Condensers are cast iron, Admiralty metal, nickel or Monel, but the materials are not wholly satisfactory. Tar acids attack steel condensers. Tin suitably supported, is used. Ni steel and the special Ni-Cr steels resist and do not discolor the distillate but have not been generally adopted. Hydrogen attack in high-temperature, high-pressure ammonia synthesis causes decrease in strength of containers. A nitride film hinders diffusion of hydrogen and a 0.30 C, 2.25 Cr steel, which can form a nitride film, is suitable. HWG(29)

Bursting Stress in High Pressure Piping: Fundamental Formulas of Design. HARVEY A. WAGNER. *Heating, Piping & Air Conditioning*, Vol. 3, 1931, pages 658–661.

The article is a discussion of the article, "Higher Pressures and Temperatures as They Affect the Design, Installation and Maintenance of Piping" by J. J. Harmon, Dec. 1930, *Heating, Piping and Air Conditioning*, page 985, with author's reply. When theoretically correct results are desired, it is the writers belief that Clavarino's formula should be used for designing piping, where closed end conditions prevail. This article compares the Birnie and Clavarino formulas and shows their differences in application. The author believes that the article is a helpful contribution to piping engineers as it discusses the fundamentals of design clearly. WAT(29)

The Thermal Expansion of Some Alloys of the System; Nickel-Iron, and the Effect of Heat Treatment. H. HIEMENZ. *Festschrift zum 70. Geburtstag von Wilhelm Heraeus*, 1930, pages 69–79.

By the proper selection of composition, almost any coefficient of expansion can be obtained with the Ni-Fe alloys. Of especial interest are the following alloys: invar, 36% Ni and 64% Fe, expansion between 0° and 100° C. almost 0 (used in the watch industry); 50% Ni and 50% Fe, for air-tight melting into glass, expansion about the same as that of Pt; alloys with 42–46% Ni, whose low expansion is compensated with a Cu case, used in the manufacture of incandescent lamps. Alloys with 25% Ni have a high expansion. The alloys all exhibit irregularities in their thermal expansion, which is represented in tabular and graphic form. By means of proper heat treatment it can be changed as much as 20%. These sometimes undesirable anomalies occur, for example, in combinations of a 36% Ni alloy with a 22–27% Ni-Fe underneath. On alloying 5% Mo with the 22–27% Ni-Fe, the expansion anomaly is suppressed and the thermal expansion increases 50%. The other alloys can likewise be improved by alloying with 5% Mo, so that the difference between the thermal coefficient of expansion at room temperature and at 100° is only 2–3%. WAT(29)

The Dependence of the Critical Shearing Stress of Cadmium Crystals on Temperature. (Ueber die Temperaturabhängigkeit der kritischen Schubspannung von Kadmiumkristallen.) W. Boas & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalt*, Sonderheft 10, 1930, pages 122–130.

The beginning of plastic elongation of cadmium crystals over the range from 20° K. to the melting point is investigated. The critical shearing stress of the transition system decreases at first linearly with increasing temperature and remains constant from about 140° below the melting point up to it. The results are given in diagrams and photographs. 14 references. Ha(29)

Scaling of Steel at Elevated Temperatures by Reaction with Gases and the Properties of the Resulting Oxides. D. W. Murphy, W. P. Wood & W. E. Jominy. *Preprint, American Society for Steel Treating*, Sept. 1931, 35 pages.

This paper presents the result of an investigation of the variables affecting the oxidation of steel in the temperature range 1095 to 1316° C. (2000–2400° F.) and shows that the effect of complex atmospheres on steel may be predicted from a knowledge of the equilibria in the systems Fe–O–C and Fe–O–H. The results of this study may be summarized as follows: The loss in weight of the metal due to scaling is proportional within limits to the area of the sample. The effect of increasing the carbon in the range 0.3 to 1.1% decreases the scaling losses. The scaling loss is lessened by a slow rate of the flow of gas. The rate of oxidation decreases as the time of exposure increases. The extent of oxidation is dependent on the relative rates of diffusion of the gases concerned in the reaction. A new method has been applied to the determination of equilibria in the reactions, $FeO + H_2 \leftrightarrows Fe + H_2O$ and $FeO + CO \leftrightarrows Fe + CO_2$ in the temperature range of 1093 to 1427° C. (2000–2600° F.). The melting point of ferrous oxide was determined from data on the two systems at 1360 ± 10° C. (2480 ± 18° F.). The heat of fusion of ferrous oxide was calculated as 28,000 calories per gram mol ± 5000 calories. X-ray data have shown that ferrous oxide is stable above its melting point having a constant 4.289 A. U. both above and below the melting point. No evidence of extensive solutions of Fe or Fe_3O_4 in FeO was obtained in this investigation. The scaling or non-scaling action of a gas atmosphere containing nitrogen, carbon dioxide, carbon monoxide, hydrogen and water vapor may be predicted with considerable accuracy for a number of steels on the basis of the equilibrium ratios derived for the two systems Fe–FeO–CO–CO_2 and Fe–FeO–H_2–H_2O. WAT(29)

The Question of Plasticity. Deformation at Low Temperatures. (Zur Frage der Plastizität. Verformung bei tiefen Temperaturen.) M. Polyanyi & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 101–104.

Three kinds of plasticity are distinguished: (1) Athermal plasticity: Occurs in crystals, i. e., zinc and cadmium-monocrystals. They possess a low elongation limit which at low temperatures becomes independent of loading velocity and temperature. After exceeding this limit, the elongation curve shows considerable strengthening. An explanation for the athermal plasticity can not be given. (2) Thermal plasticity (determined by heat treatment). It is characteristic for amorphous bodies. This type of deformation is a flowing: to each tension belongs a definite deformation velocity. This flow depends on the temperature and ceases at absolute zero. At this point, amorphous bodies can not be deformed with tensions below the theoretical shearing strength. (3) Athermal plasticity with superimposed (thermal) de-strengthening. If the range of lowest temperatures is left the thermal de-strengthening (recovery) superimposes itself on the athermal deformation and strengthening so that the deformation of strengthened crystals possesses a flow which is dependent on temperature. This kind of deformation is the one which is usually observed on multi-crystalline metal samples. The higher the temperature and the more the latter approaches the melting point the more the deformation velocity increases with the tension. 15 references are cited. Ha(29)

On the Mechanical Properties of Two Heat-Resisting Alloys. Y. Matsunaga. *Kinzoku no Kenkyu*, June 1931, pages 340–349.

The mechanical properties of two heat-resisting alloys, No. 1 (20% Cr, 80% Ni) and No. 2 (18% Cr, 12% Fe, 70% Ni) were studied. The tensile strength of these alloys increased from 70 to 110 kg/mm.² and the elongation decreased from 30 to 2% as the reduction percentage increase from 0 to 47% by cold working. The alloys heated at 100° to 200° C. show the increase of tensile strength by 5 to 10% and the decrease of elongation by about 1%. At 400° to 500° C. or higher temperatures these alloys were softened and the tensile strength decreased and the elongation increased. The temperature at which the softening takes place varies according to the composition, as well as the degree of the cold working. KT(29)

Some Alloys for Use at High Temperatures. Complex Iron-Nickel-Chromium Alloys. Part 3. The Effect of Composition and Exposure to High Temperatures. C. H. M. Jenkins & H. J. Tapsell. *Iron & Steel Institute, Advance Copy* No. 10, May 1931, 29 pages.

The effect of the addition of C and Si on the high temperature properties of alloys containing 30% Ni, 30% Cr, 4% W and Fe was studied. The tensile strengths at elevated temperatures (mainly 800° C.), the ability to withstand loads at these temperatures, and the changes in hardness produced by prolonged heatings at 800° C. were determined. The alloys with the highest strength at high temperatures contained 1.5% C. and 1% Si. An alloy of this composition hardens on being maintained at a temperature of 800° C., and microscopic examination indicated that such hardening was the result of precipitation. Alloys containing no W did not harden in this manner, and their strength at high temperatures is low. The most suitable alloys for stress resistance appear to be those which maintain, after the initial period, a fairly constant Brinell hardness when exposed to a high temperature. Contains 4 references. JLG(29)

Creep of Ultra Light Alloys under Static Loads. (La deformabilita sotto carichi statici delle leghe ultra-leggere.) N. Parravano & G. Guzzoni. *La Metallurgia Italiana*, Vol. 23, June 1931, pages 475–484.

Former data by these authors at room temperature on creep of light alloys under loads above the proportional limits (See "Static Properties of Ultra-Light Alloys," *Metals & Alloys*, Vol. 1, Aug. 1930, page 689) are examined to see what results the accelerated methods of Pomp (Extrapolation from the average rate of creep in the 50th to the 100th hour) will give when applied to them. The examination leads to the conclusion that the Pomp method gives erroneous and absurd results. If the data are taken from the 300th to the 400th hour, the error is less, but still too great. The light alloys at room temperature seem to give parabolic curves between rate of flow and time under stress. If three or four figures for rate of flow are available at sufficiently long periods of flow so that the curve is really established, plotting log of elongation against log time in hours should make possible straight line extrapolation to longer periods if the function is a logarithmic one. But data of Parravano and Guzzoni thus plotted for one 92½% Mg, 6⅔ Al, ½% Zn, ⅓% Mn alloy show straight line curve for the higher loads, e. g., those giving an elongation of 0.95% in 100 hrs., or above, but for a lower load giving an elongation of 0.015% in 100 hrs. the curve is not straight, log elongation tending to flatten out when plotted against log time. If data for the same alloy and loads be plotted as the log of the average hourly rate of flow between the 50th and 100th hour against log of load, the curve is a straight line and the tendency for cessation of flow is not shown. Whatever may be the case for steel at elevated temperatures, duralumin loaded at room temperature so that creep occurs, must be tested at least 100 hours and magnesium alloys 200 hours or more before extrapolation of any sort can be used even for a rough indication. HWG(29)

High-Temperature Metals for the Power Plant. E. W. Spring. *Iron Age*, Vol. 127, Mar. 26, 1931, pages 1004–1008; **Alloy Steels and Alloys for High-Temperature Service.** *Iron Age*, Vol. 127, Apr. 2, 1931, pages 1090–1093. **Prospects Hopeful on Metals for 1000–1500 Degrees.** *Electrical World*, Vol. 97, Mar. 7, 1931, pages 459–461.

From a paper read before the Western Power Congress at Chicago. Demand for steels that will stand up under higher working temperatures and pressures that have increased. Temperatures have increased from 750° to 1000° with 1500° F. under consideration. Pressures have increased from 600 lbs./in.² with 2500 lbs. in view. This is true of steam power plants and the oil industry. Tests show that above strain hardening temperature there is no creep limit, creep constantly going on, more rapidly with higher temperatures and increased stress. Large grain sized material has greater resistance to creep than material with reduced grain size. Forged steel with its smaller grain and higher ductility is not as stiff as cast steel. For short time high-temperature tests at 1000° F. the tensile strength and yield point are about 30,000 and 15,000 lbs./in.² respectively. Includes tables giving short-time tests on cast steel specimens previously tested in flow. Concluding portion of address discusses use of austenitic alloy steels, pointing out their advantages and disadvantages. Seating metals used are brass, monel metal, Ni alloys, rustless steel and some harder alloys, depending on the service desired. Nitralloy, a comparatively new seating metal has appeared. Total amount of deformation due to creep which can be tolerated in turbine parts should not exceed 0.2% in 20 years. Metallurgists and steel makers will meet new high-temperature and pressure demands. VSP+WHB(29)

The Graphitization of Steels at Low Temperature. (La graphitisation des aciers à basse température.) A. Portevin & P. Chevenard. *Comptes Rendus*, Vol. 193, July 20, 1931, pages 169–171.

The authors express surprise that during the course of their investigations on the tempering of quenched and "hyperquenched" steels, they discovered graphitization of a steel containing 1.6% C, 0.28% Si and 0.16% Mn. The phenomenon was brought to light owing to the extreme sensibility of the dilatometric method of investigating steel. The article is accompanied by 2 figs. upon which the findings of the authors concerning the graphitization of steels at low temperatures were based. They conclude that they have been able to transform a steel practically free from Si into the state iron-graphite by heating at temperatures below A_1. This had never been accomplished hitherto. OWE(29)

Behavior of Some Irons and Steels under Impact at Low Temperatures. Robert Sergeson. *Preprint, American Society for Steel Treating*, Sept. 1931, 16 pages.

This paper gives the results of testing, under impact, certain irons and steels at temperatures between −100 and +300° F. Properly treated nickel-molybdenum (0.15% C) S. A. E. 2115 and 2% nickel iron show excellent notched impact resistance at sub zero temperatures. Wrought iron and carbon-manganese steel show a marked falling off in notched impact resistance as 0° F. is approached. Unnotched carburized and hardened specimens of various carburizing grades when tested under impact show that the 5% and 3½% Ni steels and the 2% Ni iron possess superior qualities, especially at the sub-zero temperatures. Of the various spring steels, namely; C, C-Si, Cr, Cr-Va, Si-Mn, Cr-Ni-Mo, Ni-Mo and Ni-Si, the latter two show the highest impact resistance throughout the temperature range examined. The C steels showed the lowest. Of the stainless irons studied, the KA2 showed excellent impact resistance even to −100° F. The type AA shows a decided brittleness until temperature is raised to 350° F. at which temperature toughness is gained. The type S lies in between the KA2 and AA. WAT(29)

Metal Creep at High Temperatures. P. G. McVetty. *Machine Design*, Vol. 3, Apr. 1931, page 55.

Beside the observation of other stresses in metals, the author calls attention to the metal creep which is defined as the plastic deformation or permanent set which results from continued application of stress at elevated temperatures. See also "Creep of Metals at Elevated Temperatures," *Metals & Alloys*, Vol. 2, Aug. 1931, page 154. Ha(29)

On Some Mechanical Properties of Steel at High Temperature. K. Sasagawa. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy*, part 2, pages 199–221.

In English. An Izod specimen is heated in place and the electric furnace taken away by mechanical means, so that the specimen is broken in 2/5 sec. after removal of the furnace. Impact data are given on annealed carbon steels of 0.11, 0.23, 0.50, 0.63, 0.86 and 1.20% C at temperatures from 20° to 1000° C. The curves all show minima about 600° C. Tensile impact data are given for 0.11% C, 20 to 700° C.; 0.50% C, 20 to 900° C.; 0.86% C, 20 to 850° C.; 0.25% C, 3.7% Ni, 0.71% Cr sorbitic, 20 to 800° C.; and 0.39% C, 9.0% Ni, 16.6% Cr, austenitic, 20 to 800° C. Data are given in tables and curves. Tensile impact, short-time tensile, and creep test figures are plotted for 0.11 and 0.50% C steels. The criterion of creep limit is not stated, but at 350° C. the creep limit of 0.11% C is shown as 45,000 lbs./in.², and that of 0.50% C as 61,000 lbs./in.² Through the strain hardening range of temperatures the tensile-impact strength is lower than the short-time tensile strength, but higher above and below that range. The creep and short-time tensile curves are parallel from 350° C. to 700° C. HWG(29)

Properties of Cast Steels at High Temperatures. (Les propriétés de resistance de l'acier coule aux températures élevés.) A. Pomp. *Technique Moderne*, Vol. 21, Dec. 1, 1929, pages 766–768.

Study of a series of steels including Ni-bearing steels (Ni = 1.05, Cr = 0.27; Ni = 2.68, Cr = 0.18). Considers appropriate heat treatments and graphical representation of the resulting properties. WHB(29)

Thermomagnetic Phenomena in Steel. Raymond L. Sanford. *Preprint, American Society for Steel Treating*, Sept. 1931, 11 pages.

The great sensitiveness of magnetic properties to changes in the condition of ferromagnetic materials affords the basis of a research method by which phenomena associated with the thermal treatment of such materials can be observed, some of which are beyond the scope of other methods. This method has been called thermomagnetic analysis. In order to apply the methods of thermomagnetic analysis properly and to interpret the results with accuracy, a knowledge of the fundamental phenomena is required. The general effect of heating is to increase the magnetic permeability in the lower part of the magnetization curve and to decrease it in the upper part. The phenomena under relatively low magnetizing forces are complex and difficult to interpret because of the mutually opposing effects of various influences. These confusing effects are much less at higher magnetizations and it is possible to draw valid conclusions from results obtained in the higher range of magnetization. There are two types of magnetic change to be observed upon heating or cooling, one of which is a function solely of temperature while the other depends upon both temperature and time. The first type probably does not represent an allotropic transformation. The second type may indicate an allotropic change but not necessarily. Stress release, chemical combination or decomposition and the like may require time for their completion and should not be confused with allotropic changes. For the full development of the possibilities of thermomagnetic analysis it will be necessary to carry out much more research of a fundamental nature. Time and effort spent in this fascinating field of investigation should be amply justified, however, for it bids fair to yield results of considerable practical and theoretical value, which can be obtained in no other way. WAT(29)

LEACHING (30)

Preliminary Tests on Treatment of Titaniferous Magnetite from Mine Centre for Recovery of Iron, Titanium and Vanadium. R. J. TRAILL, W. R. MCCLELLAND & J. D. JOHNSTON. *Canada Department of Mines, Mines Branch Report* No. 720, 1931, pages 178–185.

A titaniferous magnetite from Mine Centre, Ontario, analyzed Fe 48.38%, TiO_2 12.82%, V_2O_5 0.86% and SiO_2 6.40%. 95% metallization of the Fe was readily achieved in an electric furnace (about 1000° C.) without rabbling. The magnetic concentrate analyzed Fe 61.21%, metallic iron 58.34%, TiO_2 17.61% and V_2O_5 1.07%. Leaching with $FeCl_3$ solution dissolved 50.3% of the magnetic product (82% of the iron) in 1/2 hour, leaving a residue analyzing Fe 20.82%, TiO_2 35.33% (99% of the Ti) and V_2O_5 2.10% (97.7% of the V). The high gangue content of this residue reduces its value. Magnetic concentration prior to metallization gave a concentrate (80.8%) analyzing Fe 55.9%, TiO_2 14.2%, V_2O_5 1.0% and insoluble 4.06% (10.50% in the ore). Crushing and retreating resulted in total losses in the tailing of approximately 5% of the V, 10% of the Ti, and 8% of the Fe. V is recovered (75%) from the leach residue by roasting with NaCl + $NaHCO_3$ and precipitating with Fe or Ca salts. Ti can be recovered by the sulphate process. AHE(30)

The Separation of Copper from Molybdenum in Molybdenite Concentrates by Hydrometallurgical Methods. R. J. TRAILL. *Canada Department of Mines, Mines Branch Reports* No. 720, 1931, page 186–187.

An ore containing chalcopyrite and molybdenite in a siliceous gangue and assaying Cu 4.6% and Mo 2.8% gave a recovery of 72% of the Mo by flotation in a 50% Mo concentrate carrying 3–5% Cu and 53% of the Cu in a 25% Cu concentrate. Roasting the Mo concentrate with excess S in a non-oxidizing atmosphere, followed by leaching with $FeCl_3$ gave 85% Cu extraction and left 0.5% Cu with the molybdenite. Roasting at various temperatures and leaching with soda and other solvents gave unsatisfactory results due to the sulphates formed from the alkaline earths which precipitate with the Mo as $CaSO_4$ when CaO is added to the solution to precipitate the Ca molybdate. Removal of the alkaline earths with HCl prior to roasting gave Mo recoveries of 80–90% and Cu returns of 90%. Costs are high. AHE(30)

Leaching Oxidized Copper Ores: Effect of Strength of Acid in Leaching Solvent. JOHN D. SULLIVAN & G. L. OLDRIGHT. *Report of Investigations* No. 3106, July 1931, 9 pages, *United States Bureau of Mines.*

Ajo ore leached with solutions containing 1, 2.5, 5 and 10% H_2SO_4 showed an increase of dissolution rate with increasing strength of acid. There was considerable less increase in rate for Silverbell ore. Acid consumption increased markedly as extraction progressed and was more with higher acid concentrations. It is recommended that strong acid be used for dissolving 60% of the Cu, followed by weaker solutions. Details are given. AHE(30)

Physico-Chemical Researches on Bog Ore in Japan from Metallurgical Considerations. M. KAWAGUCHI. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 99–126.

In English. Laboratory experiments of calcination, volatilization of P and S, and attempts to leach out P by caustic alkalies. HWG(30)

REDUCTION METALLURGY (31)

Smelting Secondary Aluminum and Aluminum Alloys. Pt. 10. ROBERT J. ANDERSON. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, pages 514–516.

Describes equipment required in secondary Al plant, such as ladles, pouring appliances, furnace-tools and pyrometers. VSP(31)

Secondary Aluminum. R. J. ANDERSON. Sherwood Press, Inc., Cleveland, 1931. Cloth, 6 × 9 inches, 563 pages. Price $10.00.

The metallurgy, technology and economics of scrap aluminum are exhaustively treated in this book. The author has had long experience in this field, and generally speaks with definiteness. Indeed, the outspoken, positive way in which the subject matter is expressed is one of the attractive features of the book, as well as its chief drawback. Outspoken disagreement with the definition of secondary metal put forth by the Aluminum Company of America, and some of the frequent references to that firm in the discussion of economics are couched in terms that would scarcely be expected, and seem hardly necessary in a treatise that should be written from the entirely impartial and scientific, if not judicial, point of view.

The author stresses the desirability of merging the present dozen or so secondary aluminum smelters into three or four organizations, not only for economic advantages, but for the purpose of allowing larger scale operations, with larger melts and closer technical control of the operation and product.

Sorting, sampling, remelting and refining, both as to practice and equipment, the effect of impurities, and the importance of technical control are all dealt with in detail.

The comments on the use of nitrogen, chlorine, or boron chloride gas, on spectrographic analysis for impurities, and on the making of routine hot-shortness tests on secondary metal before sending it to the foundry are of especial interest.

Recurrent references to the presence of Al_2O_3 in secondary metal, and to various methods of analyses for Al_2O_3, make the reader wish that Anderson had stated which, if any, of these methods are really reliable. But this volume does not include any methods of chemical analysis.

The book is rather costly, but should be worth its price to metallurgists and foundry superintendents who have to do with secondary aluminum.

H. W. Gillett (31)-B-

Beneficiation of Iron Ores from the Blast Furnace Viewpoint. RALPH H. SWEETSER. *Mining & Metallurgy*, Vol. 11, Sept. 1930, pages 423–426; *Rolling Mill Journal*, Vol. 4, Oct. 1930, page 546.

From paper at the Chicago meeting of the Iron & Steel Division of the American Institute of Mining & Metallurgical Engineers. Most important factor in the beneficiation of iron ores, outside of increasing iron content, is sizing. Useful work is being done by the Minnesota School of Mines and by the state of Minnesota in reference to the enrichment of ores. Extension of the life of iron ore mines depends not only on beneficiation, but also on searching out new deposits. Lake Superior ores average from 57.11% to 64.44% Fe and from 6.50% to 2.85% silica. Silica in ores is counter balanced by a corresponding decrease in the percentage of ash in coke and by progress made in the art of smelting. Includes discussion. VSP+MS(31)

New Developments in Flotation. (Neuere Ergebnisse in Flotation.) M. VAN DE PUTTE. *Metallwirtschaft*, Vol. 10, May 1, 1931, pages 349–354.

Contains 13 references. The history, development and theory of flotation are reviewed and its adaptation to various types of ores explained. Total flotation was followed by selective flotation. At first only sulphides were treated; recently, oxides also. Various inorganic and organic chemicals and oils are used to produce the foam. The best chemical must be selected separately for each ore. The flotation processes in use at the following locations are described: For the separation of gold in the Belgian Congo, for platinum in the Transvaal, for copper and nickel at Copper Cliff, for mercury in Nevada and California, and a new process for copper developed by the Union Minière. A mineralogical examination of the ore is necessary to select the correct process. The water used must be analyzed and the acidity must be controlled during the process. CEM(31)

Trends in Blast-Furnace Development. T. L. JOSEPH. *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 11–14.

Although the pig-iron industry exhibited no new major developments in 1930, there were diversified activity and progress. Concentration of low grade ores undertaken more energetically. Larger blast-furnaces built and greater tonnage achieved by enlarging hearth diameter of furnace without increasing stock-line diameter. This resulted in twofold increase in rate of blowing. Progress shown in use of larger bell clearances, construction of hot-blast stoves, design of smaller stove checkers, and installation in a few cases of cooling plates above the mantle. Greater impetus given to use of blast-furnace gas in steel plants for underfiring coke ovens, heating open hearth furnaces, firing heating furnaces, and operating gas engines. Greater attention paid to preparation of raw materials. Sizing and sintering practiced to greater extent to improve physical properties of finer ore sizes and to obtain better furnace operation with high-moisture ores. Sintering most effective when pieces smaller than 3-mesh are eliminated. Pieces between 1/2 and 1 in. in diameter offer comparatively little resistance to gas flow. JN(31)

Flotation of Native Copper at Freda, Mich. EDWARD KOEPEL. *Engineering & Mining Journal*, Vol. 131, June 8, 1931, pages 509–512.

Valuable fines from the overflow are all minus-200 mesh. Flotation for their recovery is accomplished by effecting the sand-slime separation mechanically with a Dorr classifier, rather than hydraulically. About half of the primary slime, separated out by the Dorr classifier was cut out and pumped back to the stamp mortar to furnish the necessary volume for splash purposes. The fresh water still added at the stamp-shaft urn was introduced in such a way as to wash the slime down the stamp-shaft and prevent it from creeping up, and scoring the brasses. With these changes, the amount of fresh water used in the stamp and primary classifier became 300,000 gallons per day instead of 950,000 gallons. A flowsheet of the remodeled mill at Freda, embodying flotation, is shown. WHB(31)

On the Causes of the "Iron Disintegration" of Blast Furnace Slag. (Ueber die Ursache des "Eisenzerfalls" der Hochofenschlacke.) A. GUTTMANN & E. GILLE. *Archiv für Eisenhüttenwesen*, Vol. 4, Mar. 1931, pages 401–410; *Stahl und Eisen*, Vol. 51, Apr. 2, 1931, pages 432–433.

Report No. 19 of the Committee on Slag of the Verein deutscher Eisenhüttenleute. The so-called "iron disintegration" of blast furnace slag is due to the fact that the sulphide sulphur of the slag which is combined with calcium and manganese under normal conditions combines with iron and manganese under certain conditions of the blast furnace operation. If such slags are stored in water or humid air, they disintegrate. This phenomenon is used to recognize a suspected "iron disintegration" of a slag. This disintegration can be eliminated by a certain heat treatment above 1000° C. Slags tending to disintegration can also be stabilized by a rapid cooling of the molten slag. The chemical and X-ray investigations to elucidate the above problem are described; the results are discussed; the cause of the phenomenon are outlined. GN(31)

The Normanda Smelter. W. B. BOGGS & J. N. ANDERSON. *Transactions Canadian Institute of Mining & Metallurgy*, Vol. 33, 1930, pages 351–394; Discussion, pages 395 to 397.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 790. AHE(31)

Flotation Reagents. A. M. GAUDIN. *Engineering & Mining Journal*, July 27, 1931, pages 70–71.

Reagents that promote or increase the floatability of minerals are divided into three classes: (1) collecting oils; (2) chemical collectors; and (3) activators. Examples of each are mentioned. Complete control of the reagent feeding is essential for satisfactory results. In common practice reagents are added as follows: (1) frothers, in the liquid state; (2) collecting oils in the same manner; (3) xanthates in aqueous solution, thiocarbanilide in solid form or in a frothing oil, dithiophosphates in aqueous solution or dissolved in cresylic acid, soaps in aqueous solution, fatty acids in solid or liquid state; (4) copper sulphate in solution or solid; (5) lime in olid state or in a slurry and (6) inorganic salts in either form. WHB(31)

Magnetic Concentration. A. C. ROACH. *Canadian Mining Journal*, Vol. 52, May 29, 1931, pages 551–553.

Some experiments on Sudbury copper-nickel ores are described. Screen analyses of fine ores, assay of sizes, etc; magnetic concentration of fines as a whole, and as a whole using a screen splitter are shown, and the following conclusions drawn regarding the results of the experiments: (1) while a partial separation in treating such ores is possible, its practicability is doubtful; (2) this impracticability results from the inability of the magnet to recover chalcopyrite and some gersdorffite and finer feed materials from the range of sizes to be treated; (3) magnetic concentration would be applicable when used as a scalping process preceding some form of further concentration as tabling (and) or flotation. WHB(31)

Ball Mill Studies. A. W. FAHRENWALD & HAROLD EUGENE LEE. *Technical Publication* No. 375, *American Institute of Mining & Metallurgical Engineers*, 1931, 53 pages; **II. Thermal Determinations of Ball Mill Efficiency.** A. W. FAHRENWALD, G. W. HAMMAR, HAROLD E. LEE & W. W. STALEY. *Technical Publication* No. 416, *American Institute of Mining & Metallurgical Engineers*, 1931, 13 pages.

The behavior of balls in a mill as a function of the diameter of the mill, diameter of the balls and speed of rotation is analyzed. Experimental studies were made to determine the power required for various conditions of operation. The power required was found to depend on the speed of rotation, the ball load and the diameter of the mill. Wet grinding was found to be more efficient than dry grinding. The critical speed is defined as that speed of rotation at which the balls will remain at the periphery provided no slip occurs. The most efficient grinding results from speeds above the critical. Inasmuch as most mills are run below the critical speed, more efficient grinding would result from greatly increased speeds. The average ball diameter should be such as to give an angle of nip of 17°. Contains 9 references. Part 2. The efficiency of ball mill grinding was determined from measurements of the temperature rise of the mill and charge. Efficiency determinations by this method were much higher than those based on surface areas and surface energy values. The efficiencies determined varied from 5.9 to 24.9%. The method was considered to give accurate relative values of mill efficiency. Contains 7 references. JLG(31)

Hydrometallurgical Methods of Treatment for Zinc Concentrates from Various Canadian Ores. R. J. TRAILL, W. R. MCCLELLAND & J. D. JOHNSTON. *Canadian Department of Mines, Mines Branch Report* No. 720, 1931, pages 187–191.

Roasting tests using a zinc concentrate containing Zn 37.95% and Fe 18.06% showed that the enrichment of air with O reduces the time of roasting. With increasing Fe the insoluble Zn in the calcine increases. AHE(31)

Flotation of Hematite a Laboratory Success. A. S. ADAMS, S. M. KOBEY & M. J. SAYERS. *Engineering & Mining Journal*, Vol. 132, July 27, 1931, pages 54–55.

Experimental results show that hematite ore from the Mesabi range, as found in washing-plant tailings, can be effectively concentrated by flotation in the laboratory. Optimum conditions are determined for the consistent production of a hematite concentrate analyzing 59% Fe with 74% recovery of the Fe in the feed. WHB(31)

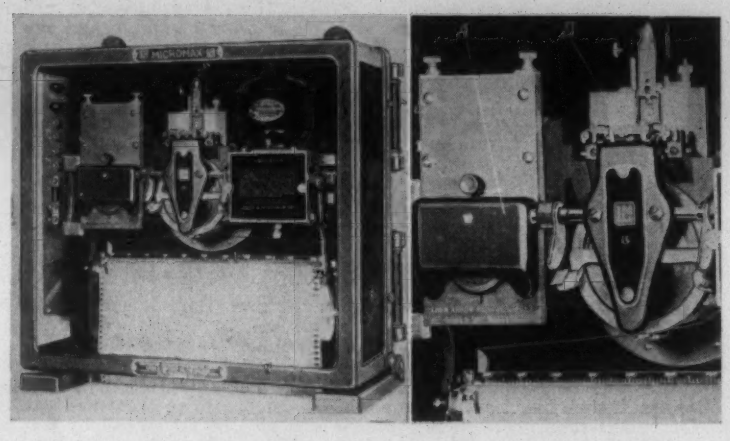
Effects of Grain Size, Temperature and Composition of Gas upon the Rate of Reduction of Titaniferous Magnetic Sands by Mixtures of CO and CO_2. K. IWASE & Y. SAITO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 391–395. In English.

The results of a few experiments are expressed in curves. HWG(31)

NEW PRODUCTS

New Potentiometer Pyrometer

The Improved L & N Potentiometer Pyrometer, Micromax, which was announced in September by the Leeds & Northrup Company of Philadelphia, requires no manual adjustments. It needs no daily attention. It eliminates the "human element" in potentiometer pyrometer operation. The instrument circuit is standardized automatically, every 45 minutes or less, giving a closer adjustment than is obtained manually. Manual adjustment of the stepping action is no longer necessary, the instrument is, in every detail, a fully automatic potentiometer pyrometer.



By virtue of its microscopically sensitive balancing device, Micromax can detect and record deflections of the galvanometer pointer amounting to 1–1000th of an inch. Micrometer sensitivity makes the recorder action responsive and speedy, sending the pen, or print wheel, across the chart paper in steps that are much more accurately proportionate to the temperature change. If necessary, the recording pen, or print wheel, can step across the entire chart in less than 22 seconds, the size of each step being closely related to the extent of galvanometer pointer deflection. It is evident, especially in automatic control and where more than one temperature is being measured, that the rapid recording feature of the Micromax pyrometer is a long-desired and looked-for advance in industrial temperature control.

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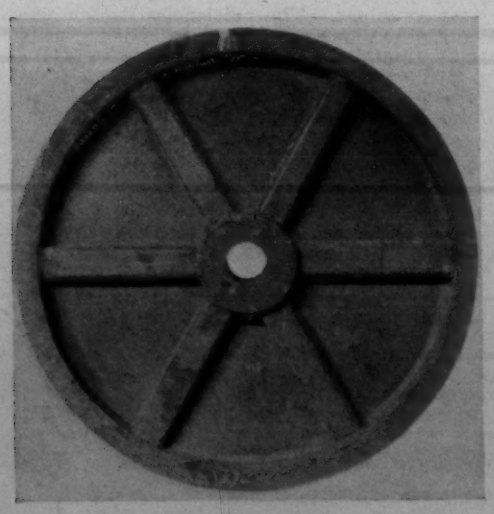
New Heavy Duty Roll Developed by Krupp

Thomas Prosser & Son, 15 Gold Street, New York City, American representatives of the Krupp Works, Germany, since 1851, announce that they are now supplying a new heavy duty chilled cast iron roll recently developed by the Krupp Works which is a product of the electric furnace with a special alloy content and has a guaranteed Sclerescope hardness of 90 to 95.

◆ ◆ ◆

New All-Welded Rolled Steel Gear Blank

Lukenweld, Inc., of Coatesville, Pa., has developed and is now manufacturing all-welded rolled steel gear blanks for use in the manufacture of cut gears. This gear blank is the culmination of a considerable period of research and experimental work, and patents on the blank have been applied for by Lukenweld, Inc.



The welded steel blank, which can be employed in the manufacture of spur, herringbone and helical gears, can be made any size from 24-inches outside diameter up. The largest all-welded gear blank made up to the present time is one with a shipping weight of 4350 lbs. It is of 66 $^3/_4$″ outside diameter, 11$^3/_4$″ width of face, 4$^1/_8$″ thickness of rim and 22$^1/_2$″ diameter hub.

While the all-welded gear blanks are ordinarily made entirely from S. A. E. 1020 carbon steel, the rims can be furnished in steels of special analyses if desired.

The hubs of the all-welded gear blanks are first gas-cut from solid rolled steel of the thickness to give the desired hub diameters. The webs are gas-cut from rolled steel plate, as are the ribs, the latter being formed into channels of the required section. The webs are arc welded to the hubs, and the reinforcing channels are welded to the web structures. The final operation consists of the circular bending of the gear ring, and arc-welding in position to form the finished gear blank. Before shipment, all of the welded gear blanks are carefully and thoroughly annealed, under pyrometric furnace control. Welding operations are under rigid procedure control and in accordance with insurance welding practice.

In the manufacture of all-welded gear blanks, no patterns are required, as the gas-cutting and arc-welding are done with blueprints of the gear design as the guide. This feature, in addition to elimination of the pattern cost, permits prompt manufacture and shipment, since no time is required for pattern-making. This time-saving is an important advantage in filling requirements occasioned by gear breakdowns.

The major advantages of the all-welded gear blank, however, from the standpoint of both the gear manufacture and the gear user, are the purity and homogeneity of the thoroughly-annealed rolled steel from which the gear blanks are made. Rolled steel, as is well known, is characterized by marked freedom from blowholes, gas pockets, hard or spongy spots and other defects. The gear rings, therefore, can be uniformly cut, and the cut teeth are sound in structure. These features minimize the losses of machining time, labor and gear material which might otherwise be caused by defects in rings discovered only after considerable cutting work had been done, frequently causing the scrapping of partially-cut gears. Moreover, the life of hobs and other gear-cutting tools is said to be increased because of the tendency toward less wear in cutting on sound and homogeneous rolled steel.

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New Testing Machines

The Tinius Olsen Testing Machine Company of Philadelphia, Pa., has made several new developments in their new testing machines.

Fig. 1 illustrates a new model motor driven ductility testing machine. The motor drive is unusually smooth in operation so that the load is applied evenly and the machine is practically noiseless. The power is applied and load weighed hydraulically. The cupping tool operating mechanism is similar in general construction to the mechanism drive used on other Olsen ductility testing machines. At all times during the test, the depth of cup and amount of load applied are indicated. As the material is inserted and clamped in place, the thickness of specimen is also shown by the graduated scale under the hand wheel. A stop is provided so that the increase in load is automatically stopped for any desired depth of cup. Then the load can be instantly released so that it gradually and smoothly increases up to the specimen fracture at which time both the depth of cup and amount of load are shown. The depth of cup for initial load may be adjusted to any amount desired. The dial at top of the machine indicates the depth of cup under all loads and after fracture remains in this maximum position until the specimen is removed. The motor and pump are stopped and started by the lever on top of the pump casing. Pressure is applied, released, or otherwise controlled by lever at the front of the pump housing.

Fig. 1.

Fig. 2 shows a motor driven production type Brinell testing machine. The present model is claimed to be unusually silent and fast in operation and very smooth application of load. Provision is made by the lever device on the side of the machine for operating by foot treadle if desired. Foot operation is effected by adjusting a rod running downward from front of segment on lever at the right side of the machine. All rotating parts are completely enclosed, and run in a bath of oil, thus assuring ample lubrication at all times, keeping the moving parts clean and reducing attention to a minimum.

Berzelius Zinc Smelters. R. SEIFFERT, ERICH KOCH & HERMANN MATTHIES. *Engineering & Mining Review*, Vol. 132, Aug. 24, 1931, pages 165–169.
The Duisburg and Bensberg plants of Berzelius Metallhütten have a combined annual capacity of over 40,000 metric tons of Zn and are typical of European retort practice. By-product plants produce about 75,000 tons of sulphuric acid. The smelter, the gas producers and muffle manufacture are reviewed. The muffles are made at the plant from a German clay containing: silica 50–55%, alumina 30–34%, Fe_2O_3 2%, lime 0.4%, and alkalies 0.4%, ignition loss being 9% and Seger cone 33. High-silica grog is used as an admixture with coke dust to increase the refractory qualities and to counteract the corrosive effect of the slag. The Bensberg smelter is described separately and briefly. WHB(31)

The Progress and Present State of Pig Iron Manufacture in Japan. S. UNOTORO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 255–282.
In English. Includes statistics, analysis of ores, cinders and slags and cokes, discussion of unsuccessful attempts to utilize titaniferous iron sands, data on blast furnace practice in Japan for pig iron and ferro-alloys. HWG(31)

Reduction of Silicon Out of Silica in Iron Ores. S. TANAKA. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 283–284.
In English. In a couple of experiments greater reduction of Si was obtained in a current of 38% CO, 62% N_2, than in pure CO. HWG(31)

Smelting in the Lead Blast Furnace. Handling Rich Charges. VI. Conditions and Problems Introduced by Increasing the Ratio of Concentration. G. L. OLDRIGHT & VIRGIL MILLER. *Report of Investigations* 3088, *United States Bureau of Mines*, Apr. 1931, 7 pages; *Metal Industry*, London, Vol. 38, May 22, 1931, pages 523–524.
The Bunker Hill smelter, with 50% Pb in its charge, was examined for an insight into what may be expected in the future in the way of materials to be received and conditions of operation to be faced. AHE+PRK(31)

Modern Blast Furnace Theory and Practice. R. H. SWEETSER & S. P. KENNEY. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 429–448.
Discussion of trend of American practice and résumé of U. S. Bureau of Mines' blast furnace studies. HWG(31)

Physical Chemistry in Reduction of Iron Ore. S. SUGIMOTO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 365–387.
In English. Mathematical discussion. HWG(31)

On the Reduction of Iron Oxides. S. SUGIMOTO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 325–363.
In English. Discussion of laboratory experiments on reduction of various iron oxides under various conditions. HWG(31)

The Metallurgy of Gold. C. S. PARSONS. *Canadian Mining Journal*, Vol. 52, July 1931, pages 621–624.
A brief résumé of recent progress in Au metallurgy including improved processes, equipment and some of the problems involved. The operation of low-grade Au deposits is more likely to come through improvements in design and construction of existing equipment than through the invention of new process or treatment. WHB(31)

Flotation. (Die Flotation.) W. LUYKEN & E. BIERBRAUER. Verlag Julius Springer, Berlin, 1931. Cloth, 6½ × 9½ inches. Price 29 RM.
Two well-known German ore dressing authorities have produced an excellent, thoroughly scientific book on flotation. About forty pages devoted to the physical and chemical nature of flotation show the progress being made in clearing up complexities of the subject. The section on laboratory technique includes good discussions of the determination of surface tension and hydrogen-ion concentration. The chapters on flotation in the plant describe not only the cells but all auxiliary apparatus. Commercial developments, including costs, price changes and production figures, are next taken up for various minerals: copper, lead, zinc, gold, silver, mercury, tin, molybdenum, tungsten, iron, manganese, aluminum, sulphur, alkaline earth minerals, graphite and coal. The last section provides flow sheets, reagent consumption and cost for six flotation plants in different parts of the world. In the appendix are about four hundred references to English, French, German and Spanish articles and a very valuable and helpful English-German and German-English vocabulary. No attempt is made to survey the patent literature.
Throughout the book great emphasis is laid on oxide flotation; and in their introduction the authors make a statement which a few years ago would have been ridiculed: "*All minerals can be floated.*"—
J. G. Attwood (31)-B-

The Reactions in the Shaft of the Cold-Blast Furnace. COLIN D. ABELL. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, page 245.
A brief note dealing with the physical chemistry of the coldblast process. OWE(31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Some Notes on Enameling Castings. A. M. CLEVERLEY. *Foundry Trade Journal*, Vol. 44, Apr. 2, 1931, page 246.
An abstract of a paper read before the Falkirk meeting of the Institute of British Foundrymen. Deals with the design of castings suitable for enameling, the treatment of articles after enameling, the fitting of enameled castings, and the warping of castings. OWE(32)

Methods of Applying Urushi Lacquer on Metal. F. S. ARAKI. *Metal Cleaning & Finishing*, Vol 2, July 1930, pages 619–620.
Urushi or genuine oriental lacquer is a sap taken from the tree known as Urushi-no-ki (Rhus Verniciferous), which is closely allied to poison sumac. The lacquer is both beautiful and durable. It is alkali and acid proof and highly resistant to heat. Two methods of application are commonly used—the quick or ordinary and the fancy or artistic. In the former, 2 or 3 coats are customary, and sometimes only 1 is used. In the latter as many as 6 coats are applied and polishing and buffing are done with great care. MS(32)

The Effect of Smelter Atmospheres on the Quality of Enamels for Sheet Steel. A. I. ANDREWS & E. A. HERTZELL. *University of Illinois Bulletin*, No. 224, Apr. 7, 1931, 15 pages.
The purpose of this investigation was to determine the effect of various gases present in the furnace during burning operation on enamels and the relation between the smelter atmosphere and the quality of the finished enamel. The methods of investigating these influences, the analyses of the enamels used in the tests, and the analyses of the atmospheres are described in detail and the following conclusions reached: In the enamels examined, all the sodium carbonate and sodium nitrate were decomposed during the first forty minutes of smelting. When the enamel batch contained sodium nitrate, the smelter atmosphere showed a higher percentage of oxygen during the first forty minutes than without this constituent. Atmospheres of 96 to 100% N and 93 to 100% CO_2 were not deleterious to the enamels. Reducing atmospheres in the smelter were not deleterious. It can be stated, in general, that N_2CO_2 and reducing atmospheres do not destroy enamels for sheet steel as used in the tests and that sulphur dioxide is very deleterious. Ha(32)

The Warner reverse bend testing machine is shown in Fig. 3. This machine can be supplied in various sizes and types and either hand operated or motor driven. Operation of the machine consists in bending a specimen back and forth over definitely shaped jaws so that smooth bending in opposite direction is alternately effected. The jaws in the machine illustrated have a relatively small radius close to where the specimen is gripped. The two large rollers at the top of the machine are caused to oscillate back and forth and travel in a path parallel to the tops of the grip blocks in which the specimen is held. Fast speed is effected in the hand operated machine shown either by operating with the bar at the top of the machine or with the hand wheel on the large gear at the right side for slower speed and to provide more power for larger specimens the hand crank is placed on the pinion spindle as shown in the illustration. A counter just over the driving gear is provided to show the number of strokes required to break the specimen.

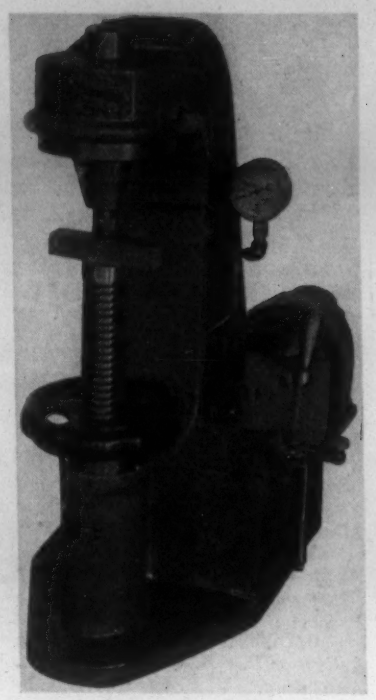

Fig. 2.

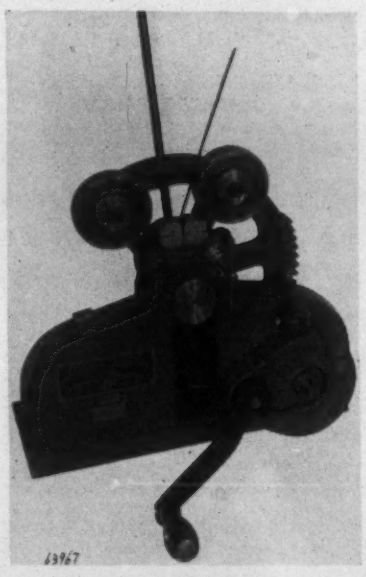

Fig. 3.

The Olsen Lundgren static dynamic balancing machine, as illustrated in Fig. 4, is capable of handling rotors weighing from 125 to 1000 lbs. It is suitable for dynamically balancing Diesel engine crankshafts, electrical armatures, fans, turbine rotors, rolls, etc. Other standard sizes of this Style "S" machine will balance rotors weighing from 4 to 15,000 lbs. Balancing is done with unusual rapidity and extreme accuracy. The operator can see clearly the progress of balancing operation while the machine is in motion which is a characteristic unusual in balancing machines and aids materially in fast production with accuracy.

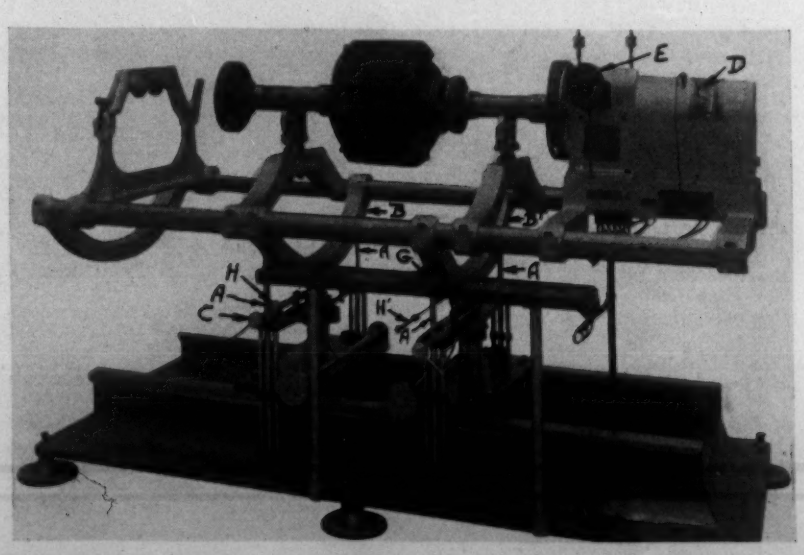

Fig. 4.

The amount of unbalance in a rotor is determined by adjusting, while the machine is in motion, an artificial unbalance weight until it is exactly equal and opposite to the unbalance in rotor. Reading of the amount and angular position of this artificial unbalance weight then determined the amount and position of weight to be removed or added to the rotor to properly balance it. Two readings are taken, one at either end so that a corrective dynamic couple can be applied to the part being balanced. The part being balanced in the illustration is an electric motor armature. It is supported on rollers attached to a light but stiff vibrating frame constructed of high test aluminum alloy cross members and tubular steel side rails.

PATENT DEPARTMENT

An arrangement with Mr. W. M. Corse, Metallurgical Engineer, Washington, D. C., who operates an Engineering Information Service, enables us to publish a list of important patents from the United States, Canada, England, Germany, France, Switzerland, Denmark, Holland, Sweden, Norway and Italy.

Copies of patents and translations will be supplied at reasonable cost. Patent searches made at minimum rates. Estimates cheerfully given.

Information about this service may be secured by writing to the Patent Department, METALS & ALLOYS, 810 Eighteenth Street, Washington, D. C.

United States Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Metallic refractory material. (*W-Si-Ni*). J. G. Donaldson, *et al.*, 1,820,966, 12/21/26.

Smelting of ores. F. M. Becket, 1,820,998, 4/13/28.

Method of cleaning galvanizing pots. F. L. McMeans, 1,821,105, 8/9/29.

Tuyère block for metallurgical furnaces. D. Cushing, 1,821,175, 11/11/29.

Method of preparing rare refractory metals. F. H. Driggs, *et al.*, 1,821,176, 10/1/28.

Apparatus for molding in sand. W. A. Miles, 1,821,270, 4/25/29.

Process of rolling alloy steel. H. M. Givens, 1,821,382, 11/20/29.

Process of decarburizing iron or steel or their alloys. W. Schottky, 1,821,407, 6/25/29; Germany 6/27/28.

Rolling mill. B. R. Shover, *et al.*, 1,821,483, 11/25/29.

Annealing. V. B. Browne, 1,821,493, Original filed 5/28/27, 9/26/29.

Method of decorating watch dials, etc. J. C. McFarland, 1,821,561, 6/22/28.

Separation of metals. G. U. Greene, 1,821,634, 8/8/29.

Removal of tin from antimonial lead and alloy. T. D. Jones, 1,821,643, 8/31/29.

Furnace hearth. G. C. McCormick, 1,821,658, 4/30/30.

Method of rolling sheet metal. J. M. Felton, *et al.*, 1,821,751, 7/12/28.

Process of making synthetic pig iron. T. F. Baily, *et al.*, 1,821,783, 1/28/28.

Hardening furnace with continuously operating charging device. E. Goerig, *et al.*, 1,821,832, 3/28/29; Germany 12/18/28.

Wire drawing machine and process of threading the same. E. J. McIlvried, 1,821,845, 7/8/29.

Electrodeposition of metal. (*Zinc.*) W. H. Hannay, *et al.*, 1,821,970, 2/-21/29.

Method for treating arsenious ore. A. R. Lindblad, 1,822,103, 4/22/30; Sweden 4/24/29.

Welding. C. A. Bowlus, 1,822,197, 12/6/29.

Core baking apparatus. H. L. Demmler, 1,822,205, 2/21/27.

Means for igniting gas expelled from foundry molds. F. E. McCabe, 1,822,229, Original filed 9/19/25; 3/25/27.

Process and apparatus for molding tubes. W. H. Watt, 1,822,256, 5/4/29.

Purification of ores. F. M. Becket, 1,822,266, 11/17/28.

Welding machine. W. F. Pioch, *et al.*, 1,822,371, 6/20/29.

Method of dezincing mattes and slags. M. G. Fowler, *et al.*, 1,822,396, 1/-14/29.

Core oils and process for producing same. E. H. McArdle, 1,822,411, 3/14/30.

Composition of matter and method of making the same. (*Hard metal alloy.*) E. B. Welch, 1,822,426, 9/27/29.

Method of accelerating the reaction in aluminothermic processes especially in their application to welding. W. Sander, 1,822,506, 12/23/30; Germany 11/16/29.

Induction electric furnace. E. F. Northrup, 1,822,539, 3/9/29; 1,824,618, 7/9/29.

Recovering copper from slags. M. G. Fowler, *et al.*, 1,822,588, 1/14/29.

Art of coiling hot metal stock. J. R. George, *et al.*, 1,822,589, 2/23/29.

Metallic composition and process of preparing the same. (*Hard metal.*) L. L. Wyman, 1,822,720, 7/15/29.

Steel alloy. D. F. Youngblood, 1,822,792, 5/10/29.

Method of treating aluminum base alloys which are subject to growth. R. S. Archer, *et al.*, 1,822,877, 12/22/28.

Presses for drawing sheet metal. C. J. Rhodes, 1,822,906, 10/29/29; Great Britain 12/17/28.

Method of and apparatus for handling ingots. A. R. Keller, 1,822,930, 2/-25/28.

Disappearing feeder for metallurgical furnaces. R. A. Wagstaff, 1,822,944, 10/11/27.

Process for treating metals. H. H. Stout, 1,822,939, 8/15/28.

Metallurgical process. R. F. Meyer, 1,822,995, 10/8/30.

Reverberatory furnace. W. F. Sklenar, 1,823,005, 8/15/29; Great Britain 10/22/28.

Process and apparatus for casting metals and ceramic masses according to the centrifuging method. C. Fritzsche, 1,823,037, 3/15/29; Germany 3/-21/28.

Manufacture of seamless tubes. O. Bamberger, 1,823,080, 3/25/26; Germany 2/20/26.

Method of and apparatus for producing profile strips from sheet magnesium alloys. E. de Ridder, 1,823,489, 1/28/28; Germany 1/28/27.

Apparatus for the manufacture of welded structures. T. A. Lucy, 1,823,551, 9/21/27.

Method and means for preparing metal for pouring. A. A. Holbeck, 1,823,604, 2/15/29.

Method of and apparatus for casting. W. N. Thode, 1,823,671, 1/2/29.

Coating and heat treating apparatus. A. O. Austin, 1,823,675, 2/12/25.

High temperature thermocouple. H. C. Staehle, 1,823,706, 11/12/29.

Method of producing openings through hard metal compositions. G. F. Taylor, 1,823,709, 1/22/31.

Drying and roasting furnace. G. E. Connolly, 1,823,787, 5/1/30.

Electromagnetic testing of steel wire ropes and other articles of magnetizable material. T. F. Wall, 1,823,810, 12/20/28; Great Britain 12/20/27.

Process of obtaining beryllium and aluminum compounds. C. B. Sawyer, *et al.*, 1,823,864, 10/14/30; Canada 1/6/27.

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Casting machine. J. Polák, Re 18,202 (Original 1,717,254, 6/11/29), 6/8/31; Czechoslovakia 9/1/27.

Induction furnace. P. H. Brace, 1,823,873 & 1,823,874, 1/23/30 & 4/23/30.

Pyrites roasting. J. E. Little, 1,823,907, 5/4/28.

Induction furnace. T. H. Long, 1,823,908, 9/20/30.

Process for the production of silver plated metal articles such as table requisites. G. Henke, 1,823,938, 1/27/30; Germany 12/11/28.

Induction furnace. N. R. Davis, 1,823,970, 9/26/29; Great Britain 10/9/28.

Apparatus for shearing flanges from ingots. W. J. Schultz, *et al.*, 1,823,991, 8/20/29.

Method and apparatus for rolling sheets. R. J. Wean, 1,824,001, 10/31/29.

Foundry molding machine. T. W. Bullock, 1,824,009, 9/14/29; Great Britain 10/1/28.

Ladle stopper construction. A. J. Jackson, 1,824,019, 10/2/29.

Recovery of precious metals from refractory ores. R. F. Meyer, 1,824,093, 12/13/28.

Process for electrolytic deposit of heavy metals. M. Schlötter, 1,824,100, 1/16/29; Germany 11/9/28.

Welding method. (*Facing with hard metal.*) H. J. Morgan, 1,824,166, 1/-16/29.

Rolling mill. A. F. Jobke, 1,824,211, 5/2/28.

Underwater torch and method therefor. E. Ellsberg, 1,824,397, 12/20/27.

Apparatus for demagnetizing magnetically conveyed material. W. McKee, 1,824,403, 6/11/30.

Heat treating razor blade strips. T. C. Sheehan, 1,824,410, 7/12/29.

Hotbed. W. McKee, 1,824,439, 8/28/29.

Pattern lifting device. D. B. Dimich, 1,824,468, Original 10/23/29; 12/-26/30.

Intersupported disk for furnace conveyors. F. A. Fahrenwald, 1,824,470, 12/10/30.

Process for smelting material containing tin oxide. M. G. Freise, *et al.*, 1,824,-475, 2/19/30; Germany 3/4/29.

Apparatus for operating shaft furnaces in the thermal treatment of granular material. O. Hubmann, *et al.*, 1,824,483, 3/26/30; Germany 2/3/27.

Rolling sheets. J. Kennedy, 1,824,496, 1/19/29.

Method of treating wire. R. C. Pierce, 1,824,568, 10/25/29.

Method of making polished annealed stainless steels. F. Locke, 1,824,608, 6/18/29.

Means for feeding sheet bars to furnace conveyers. A. L. Larsen, 1,824,742, 7/31/30.

Furnace. E. G. de Coriolis, 1,824,747, 9/8/30.

Process of heat treating metal. J. J. Bowden, 1,824,865, 12/29/30.

Recuperative soaking pit. A. L. Culbertson, 1,824,876, 9/9/27.

Tuyère. L. M. Nesselbush, 1,824,919, 7/17/29.

Pickling of stainless steel. N. H. Schermer, 1,824,932, 8/21/30.

Metallurgical process and apparatus. F. Lawaczech, 1,824,960, 12/22/27. (Original 3/16/27); Germany 12/17/25.

Alloys and process for improving workability of same. N. B. Pilling, 1,824,966, 9/30/27.

Metallurgical furnace. H. Navratiel, 1,825,011, 12/27/28; Germany 1/2/28.

Extrusion press. F. Singer, 1,825,017, 8/25/30; Germany 4/2/28.

Furnace. W. Grothe, 1,825,059, 7/9/28.

Electric welder. E. A. Hobart, 1,825,064, 7/19/29.

Adjustable die (*for sheet metal working*). W. C. Johnson, 1,825,067, 10/24/29.

Furnace conveyor. R. J. Wean, 1,825,107, 10/6/30.

Metallic lining for high temperature vessels. S. T. McDermott, 1,825,154, 7/23/30.

Electrodeposited pattern. (*For a casting.*) A. K. Laukel, 1,825,189, 12/3/28.

Recovery of metals and metal compounds soluble in ammoniacal liquors. L. Schlecht, *et al.*, 1,825,211, 3/29/28; Germany 4/27/27.

Optical pyrometer. R. Hase, 1,825,229, 12/9/26; Germany 2/26/26.

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Process of producing castings of magnesium and high grade magnesium alloys, A. L. Mond, 1,825,242, 12/14/29; Great Britain 12/19/28.

Centrifugal molding apparatus. W. H. Beatty, 1,825,302, 6/17/29.

Electrode holder (*for welding electrodes*). H. H. Heckmann, 1,825,314, 1/-30/28.

Method of extrusion and apparatus therefor. C. O. Evans, 1,825,343, 3/5/30.

Regenerative-furnace-controlling apparatus. W. Sykes, 1,825,372, 1/22/30.

Annealing furnace. H. Alinder, *et al.*, 1,825,380, 7/23/28; Great Britain 6/29/28.

Combined goggles for grinding and welding. A. R. Dobbs, 1,825,386, 5/20/31.

Apparatus for testing physical properties of materials. R. Esnault-Pelterie, 1,825,387, 12/14/26; Great Britain 6/30/26.

Hot top for ingot molds. M. G. Dumas, 1,825,445 & 1,825,446, 12/5/29 & 8/23/30.

Method of reclaiming stainless steel scrap. L. B. Lindemuth, 1,825,463, 7/30/30.

Process of reducing the quantity of sulphurous acid gas set free from copper glance on its roasting. M. Miyake, 1,825,536, 10/18/29, renewed 8/-24/31.

Corrugated pot. C. H. Stevenson, 1,825,556, 7/12/28.

Method of treating metals and treating agent therefor. F. J. Wilson, *et al.*, 1,825,565, 12/17/28.

Cutting and welding machine. A. Schmidt, 1,825,606, 5/17/29; Austria 5/19/28.

Austrian Patents

Subject of Invention, Patentee, Patent No. and Date of Beginning of Term of Patent.

Electric bright-annealing furnace. Siemens-Schuckertwerke Akt.-Ges., 124,-245, 4/15/31.

Method of preventing surface decarburization and carburization in the annealing of steels containing carbon. Vereinigte Stahlwerke Akt.-Ges., 124,246, 4/15/31.

Process for locally hardening objects by nitriding. Aubert & Duval Frères, 124,247, 4/15/31.

Ironless induction furnace for making alloys, particularly iron-silicon alloys. Siemens-Schuckertwerke Akt.-Ges., 124,250, 4/15/31.

Steel and cast iron alloys which can be hardened by nitriding. Aubert & Duval Frères, 124,268, 4/15/31.

Process for preparing ore slimes for blast roasting, on a Dwight-Lloyd machine for example. Metallges. Akt.-Ges., 124,264, 4/15/31.

Means for regulating electric arc furnaces. A. E. G. Union Elektricitäts Ges., 124,251, 4/15/31.

Process and anode for increasing the thickness of the electrolytic deposit at the points of forks and the edges of spoons. Berndorfer Metallwarenfabrik A. Krupp Akt.-Ges., 124,266, 4/15/31.

Process for coating metallic objects with one or more metals or alloys. Research Corp., 124,253, 4/15/31.

Process for increasing the radiation constant or the heat absorptivity and emissivity of metallic surfaces, objects, etc. Vereinigte Aluminium-Werke Akt.-Ges., 124,257, 4/15/31.

Electric soldering device. Elektrische Löt-u. Schweiss G. m. b. H., 124,216, 4/15/31.

Device for electric spot welding of seams. A. E. G. Union Elektricitäts Ges., 124,218, 4/15/31.

Process for coating objects which are to withstand a high temperature, such as metals, graphite, electrodes, etc., with a hard, glossy, metallic coating of graphite. Presslicht-Patentverwertungsges. m. b. H., 124,214, 4/15/31.

Process for protecting sheet iron vessels against chemical corrosion by coating them with steel. R. Novelly, 124,534, 4/15/31.

Steel die and process for making the same. Aubert & Duval Frères, 124,553, 7/15/30.

British Patents

Note: When the date applied for differs from the date on which the application was lodged at the British Patent Office, the former date is given, followed by *.

Subject of Invention, Patentee, Patent No. and Filing Date.

Process and apparatus for plating metal articles. Major Engineering Corp., 354,706, 2/7/30.

Manufacture of strip-like material. Cold Metal Process Co., 354,707, 12/-19/29*.

Production of magnesium alloys. Dow Chemical Co., 354,744, 3/11/30.

Manufacture of refractory metals such as tungsten. General Electric Co., Ltd., *et al.*, 354,785, 5/10/30.

Nickel-chromium alloys. General Electric Co., Ltd., *et al.*, 354,765, 5/12/30; 355,083, 9/29/30.

Process for treating vanadium ores, and particularly vanadates of lead and of other metals. A. Gildemeister, *et al.*, 354,816, 6/24/29*.

Processes of coating metals. British Thomson-Houston Co., Ltd., 354,887, 5/28/29*.

Methods of and machines for making welded tubing. Jackson Tube Co., Inc., 354,913, 6/11/30.

Mounting means for the heating-elements of electric resistance furnaces. Hevi Duty Electric Co., 354,928, 6/22/29*.

Anodes for electroplating. Udylite Process Co., 354,939, 11/13/29*.

Machines for welding. E. G. Budd Mfg. Co., 354,947, 8/1/29*.

Tubes for use in highly heating molten metals, liquids, vapors and gases. F. Krupp Akt.-Ges., 354,965, 7/20/29*.

Mounting rolls for cold-rolling mills. Maschinenbau-Akt.-Ges. Vorm. Ehrhardt & Sehmer, *et al.*, 354,969, 7/16/30.

Welding-agents. Vereingte Stahlwerke Akt.-Ges., 354,995, 8/19/29*.

Apparatus for bending tubes. British Tube Mills, Ltd., *et al.*, 355,027, 8/-16/30.

Tungsten carbide. British Thomson-Houston Co., Ltd., 355,041, 8/29/29*.

Foundry molding-machines. R. F. Ringle, 355,044, 9/2/30.

Treatment of copper matte. United Verde Copper Co., 355,078, 9/25/29*.

Rock drills, cutting-picks and other hard metal tools. F. Krupp Akt.-Ges., 355,127, 8/21/30*; 356,029, 8/22/30*.

Process for lining tube branches, consisting of welded tubes, with a protective internal coating. R. Traut, 355,148, 8/12/30*.

Method of manufacturing profiled metal pieces, such as metal plates, strips or the like. H. Seiferth, 355,152, 2/1/30*.

Electric arcs for welding and like purposes. Presslicht-Patent-Verwertungs Ges., *et al.*, 355,153, 12/2/29*.

Billet heating furnaces. Scovill Manufacturing Co., 354,717, 4/7/30*.

Processes of treating iron ores. Comstock & Wescott, Inc., 355,235, 10/-24/29*.

Process for obtaining iron from iron carbonyl. Vereinigte Stahlwerke Akt.-Ges., 355,302, 3/8/29*.

Process for producing a coating-composition for protecting surfaces against rust, decomposition, heat, fire and the like. R. T. Victoria Vegyeszeti Müvek, 355,266, 1/29/30*.

Coating metals. J. H. Gravell, 355,286, 3/4/30*.

Process for coating metal bodies with tungsten bronzes and/or molybdenum bronzes. Egyesult Izzolampa es Villa-Mossagi Reszvenytarsasag, 355,334, 12/23/29*.

Water-cooled molds for casting metals, and method of using same. Heraeus Vacuumschmelze Akt.-Ges., *et al.*, 355,395, 10/12/29*.

Zinc alloys. Illinois Zinc Co., 355,422, 10/18/29*.

Magnetic alloys. Callender's Cable & Construction Co., Ltd., *et al.*, 355,456, 7/14/30.

Method of and apparatus for coating wire. Johnson Steel & Wire Co., Inc., 355,463, 7/17/30.

Four-high mills. Maschinenbau-Akt.-Ges. Vorm. Ehrhardt & Sehmer, 355,487, 9/16/29*.

Process for patterning metallic hollow cylindrical or the like bodies. K. Takeda, 355,523, 9/3/30.

Manufacture of metal tubes and other metal tubular articles. Wellman Seaver Rolling Mill Co., Ltd., *et al.*, 355,524, 9/4/30.

Electrodes for use in electric arc-welding or the fusion-deposition of metals. Quasi-Arc Co., Ltd., *et al.*, 355,552, 9/25/30.

Device for detecting leakage in a vessel containing an electrically conductive liquid bath. Vereinigte Stahlwerke Akt.-Ges., 355,594, 12/3/29*.

Process for converting ferro-phosphorus rich in silicon into ferro-phosphorus of high phosphorus-content free from or poor in silicon. I. G. Farbenindustrie Akt.-Ges., 355,610, 12/17/29*.

Conveyer for metal sheets. Copperized Steel, Ltd., 355,628, 12/27/29*.

Hot-blast stoves. H. A. Brassert & Co., 355,674, 3/19/30.

Method of producing hard alloys. Vereinigte Stahlwerke Akt.-Ges., 355,782, 3/26/29*.

Connectors for welding cables and welding heads. E. G. Budd Mfg. Co., 355,-784, 4/29/29*.

Continuous-rolling mechanism for rolling bands and strips. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 355,698, 9/3/29*.

Method of propagating endothermic reactions in electric arc furnaces. Buffalo Electric Furnace Corp., 355,700, 6/27/29*.

Means for supporting resistor coils in electric furnaces. D. F. Campbell, *et al.*, 355,701, 5/19/30.

Roasting of ores containing iron and copper sulphides. H. K. A. Lassen, 355,664, 5/19/30.

Process for the manufacture of aluminum and its alloys. T. R. Haglund, 355,-792, 5/22/30.

Welding of metal sheets. L. W. Blanchard, 355,688, 5/26/30.

Manufacture of coated metal sheets. L. W. Blanchard, 355,796, 5/26/30.

Recuperative counter-flow furnace. Hevi Duty Electric Co., 355,839, 6/-5/29*.

Treatment of zinciferous materials for the removal of cadmium or cadmium together with lead. New Jersey Zinc Co., 355,840, 10/15/29*.

Method of metallizing articles of organic origin. K. Richter, 355,848, 6/6/30.

Machines for pushing foundry molds out of their boxes. British Insulated Cables, Ltd., *et al.*, 355,889, 7/5/30.

Mandrels of tube-forming apparatus. Demag Akt.-Ges., 355,898, 7/14/30.

Subaqueous burner for autogenous cutting and welding. H. Topper, 355,909, 9/5/29*.

Process for increasing the resistance to corrosion of objects made from alloys of magnesium with manganese. I. G. Farbenindustrie A.-G., 355,920, 8/23/29*.

Furnace for melting metals of relatively low-melting points. W. G. Armstrong, Whitworth & Co., Ltd., *et al.*, 356,037, 11/12/30.

Refining copper. J. Leemans, *et al.*, 356,077, 1/8/31.

Presses for drawing hollow bodies. F. Krupp A.-G., 356,082, 1/22/30*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Device for casting metals. E. Bornand, *et al.*, 314,096, 12/11/29.

Metal-protected mirror. S. C. Langdon, 314,148, 8/22/30.

Process of manufacturing alloys. (*Cu, Si and Co, Ni, Cr or Fe.*) The American Brass Co., 314,185, 1/15/29.

Process of treating nickel-copper solutions to remove iron. The Falconbridge Nickel Mines, Ltd., 314,218, 10/10/30.

Process of decomposing titanium ores. I. G. Farbenindustrie Akt.-Ges., 314,219, 9/28/28.

Method of treating malleable iron. Fittings, Ltd., 314,223, 4/24/31.

Metallurgical furnace. The New Jersey Zinc Co., 314,247–314,249, 11/4/30.

Tube manufacture. The Union Metal Mfg. Co., 314,275, 2/11/29.

Apparatus for making tapered tubular poles. Same patentee, 314,276, 12/-5/30.

Welding method. Same patentee, 314,277, 12/5/30.

Tubular column forming machine. Same patentee, 314,278, 12/5/30.

Electrode holder (for electric furnaces). W. H. Walter, 314,319, 5/13/31.

Heating furnace (for billets, sheet bars, etc.). A. L. Culbertson, 314,335, 12/-3/30.

Method of preparing metal for painting. J. H. Gravell, 314,344, 2/10/30.

Foundry facing composition. B. F. Wallace, 314,377, 6/23/30.

Apparatus for manufacturing castings. J. E. Wright, 314,380, 5/10/30.

Process of electrolytically refining metallic aluminum. Aluminium Industrie Akt.-Ges., 314,384, 12/2/29.

Starting cathode for the electrolytic refining of copper and other metals. The United States Metals Refining Co., 314,437, 3/14/30.

Electric furnace. H. I. Altshule, *et al.*, 314,458, 4/17/29.

Electric welding apparatus. E. Bornand, *et al.*, 314,460, 5/1/31.

Apparatus for producing rolled bodies from pulverized materials. C. A. Brackelsberg, 314,474, 12/2/29.

Apparatus for galvanizing thin chains. M. Fessler, 314,489, 7/29/30.

Device for guiding the mandrel bars of tube push benches. Demag Akt.-Ges., 314,586, 10/29/30.

Metal coating method. The Hudson Motor Car Co., 314,607, 3/15/29.

Centrifugal casting machine. The Paper & Textile Machinery Co., 314,624, 11/23/29.

Electric arc welding plant. The Quasi-Arc Co., Ltd., 314,628, 2/24/31.

Process of treating ores. (*Conversion to water-soluble sulphates.*) E. A. Ashcroft, 314,706, 7/22/30.

Press. E. Haverbeck, 314,729, 2/27/31.

Paper machine wire manufacture. C. Johnson, 314,738, 6/4/31.

Heat-absorbing method for metallic surfaces. (*Production of oxidic layer.*) E. Roth, 314,764, 11/26/29.

Process of producing metal nitrides. R. R. Walter, 314,776, 5/12/28.

Process of casting metals or alloys. British & Dominions Feralloy, Ltd. 314,797, 2/7/31.

Method of making metal dies. The Edward G. Budd Mfg. Co., 314,799, 5/8/29.

Process of preparing rare metals (U) by electrolytic decomposition. The Canadian Westinghouse Co., Ltd., 314,802, 12/31/28.

Method of preparing rare refractory metals. (*W, Mo, Cr, U.*) The Canadian Westinghouse Co., Ltd., 314,805, 9/20/29.

Alloy. (*Zn-Cu-Al-Fe-Mn.*) Same patentee, 314,810, 5/23/30.

ngot mold. The Firth Sterling Steel Co., 314,837, 5/16/30.

Process of treating ores. The Sulphide Corp., 314,884, 5/27/30.

Manufacture of axes. Vaughan & Bushnell Mfg. Co., 314,893 & 314,894, 4/26/30.

Centrifugal casting method. W. H. Millspaugh, 314,911, 6/4/29.

Apparatus for melting, casting and feeding linotype metal. E. E. Beard, 314,-921, 1/24/30.

Process for manufacturing iron having good machining properties. F. Borggrafe, 314,923, 7/16/29.

Hot top for ingot molds. W. M. Charman, 314,925, 8/8/30; 315,121, 12/-13/29.

Lining for ingot mold hot tops. W. M. Charman, 314,926, 11/19/30.

Metal plate flanging machine. V. C. Norquist, 314,969, 3/18/31.

Press for producing cable sheathings. Felten & Guilleaume Carlswerk Akt.-Ges., 315,038, 10/18/29.

Metal ribbon manufacture. The Griscom-Russell Co., 315,056, 2/13/31.

Tarnish resistant and rust proof alloy. (*Fe-Ni-Cr.*) The International Nickel Co., Inc., 315,059, 11/28/27.

Process of recovering nickel. Same patentee, 315,060, 10/11/29.

Ferrous base article. The Molybdenum Corp. of America, 315,071, 3/23/29.

Mold wiper for hot tops. W. M. Charman, *et al.*, 315,122, 8/8/30.

Galvanizing rack centrifuge. H. B. Newhall, 315,126, 9/26/30.

Ore roasting furnace. W. J. Cummings, *et al.*, 315,136, 9/2/30.

Cross rolling machine. P. B. Abramsen, 315,139, 2/4/30.

Aluminum silicon alloy. The Aluminium Limited, 315,200–315,202, 9/6/30, 9/6/30 & 9/9/30.

Method of making metal stampings. The Edward G. Budd Mfg. Co., 315,215, 5/30/30.
Method of casting metal sheets. The Cleveland Graphite Bronze Co., 315,229, 12/16/29.
Metal working machine. The Motor Products Corp., 315,279, 5/12/30.
Method of treating mattes and slags. The United Verde Copper Co., 315,321, 1/9/30.
Method of recovering copper from slags. Same patentee, 315,322, 1/9/30.
Apparatus for manufacturing metallic sheets, strips or wire. S. O. Cowper-Coles, 315,354, 1/5/31.
Apparatus for making profile metal articles. H. Seiferth, 315,409, 1/8/31.
Alloy. (*Cu-Mn-Zn.*) J. N. White, 315,419, 11/8/30.
Metallurgical furnace. The Canadian Westinghouse Co., Ltd., 315,440, 5/20/27.
Welding rod. The Steel Co. of Canada, Ltd., 315,502, 3/26/30.
Ore metallurgy. The United Verde Copper Co., 315,513, 9/24/30.
Method of treating mattes. Same patentee, 315,514, 9/24/30.

Danish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for making tools having a homogeneous structure and great hardness. F. Krupp Akt.-Ges., 44,289, 7/24/29.
Process for tinning "rustless" chromium steel or chrome-nickel steel. AB. Separator, 44,306, 11/28/30.
Process for making welding wire. Vereinigte Stahlwerke Akt.-Ges., 44,308, 7/23/30.
Process for electroplating bulk goods in drums. Soc. An. Waldberg, 44,353, 11/4/29.
Chrome-iron alloy for spraying and rustless objects produced therewith. B. Vervoort, 44,390, 8/12/29.
Means for preventing corrosion in mercury vapor rectifiers. Fusi Denki Seizo K. K., 44,393, 2/10/30.
Process for forming the blade or bowl of spatulate metallic objects, especially silverware. K. A. Marthinson, 44,428, 3/27/30.
Machine for extruding metal tubing, or similarly functioning machines. W. T. Henley's Telegraph Works Co., Ltd., 44,466, 6/21/30.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Machine for plugging tap holes. E. Schiegries, 710,335, 1/31/31.
Apparatus for treating foundry sand and similar products. E. F. Dehomme, 710,144, 1/29/31.
Process for making metal tubes covered with wood veneer. Theodor Muller & Co. G. m. b. H., 710,153, 1/29/31.
Improvements to drawing and coiling apparatus. Scovill Mfg. Co., 710,185, 9/12/29.
Improvements to electric heating elements. Geo. Bray & Co., Ltd., 710,154 & 710,155, 1/30/31.
Automatic mechanism for regulating electric arcs. R. Sarazin, Addition 39,043 (1st addition to 682,422, 9/28/29), 9/5/30.
Process for making tubes which are ready for shipment after being coated with a rust-preventive composition. Vereinigte Stahlwerke Akt.-Ges., 710,647, 2/5/31.
Drive for hot beds having oblique rollers. Demag Akt.-Ges., 710,679, 2/6/31.
Improvements to ferrous alloys. Cie. Nationale des Radiateurs, 710,400, 2/2/31.
Machine for plugging tap holes. Vereinigte Stahlwerke Akt.-Ges., 710,689, 2/6/31.
Process for the electrolytic extraction of aluminum from a double chloride. E. Daudonnet, 710,706, 4/19/30.
Rolling process. G. Muller, 710,450, 2/4/31.
Improvements in the casting of metals and alloys. British & Dominions Feralloy, Ltd., 710,463, 2/4/31.
Draw-bench with tractive-force regulator. Siegener-Maschinenbau Akt.-Ges., *et al.*, 710,545, 1/30/31.
Improvements to machines for working metal by means of electricity. J. E. J. Languepin, 710,722, 5/2/30.
High-frequency vacuum furnace. Telefunken Ges. für Drahtlose Telegraphie m. b. H., 710,618, 2/5/31.
Heating grids for electric resistance furnaces. W. S. Smith, *et al.*, 710,631, 2/5/31.
Centrifugal apparatus for the electrolytic deposition of metals. Soc. An. Waldberg, 710,753, 5/8/30.
Surface-hardened journal. Deutsche Edelstahlwerke Akt.-Ges., 710,287, 5/12/30.
Machine for casting by projection. Eckert & Ziegler G. m. b. H., 710,868, 1/20/31.
Process for making metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 710,792, 2/7/31.
New light metal alloy. The Birmingham Aluminum Casting (1903) Co., Ltd., 710,908, 2/5/31.
Improvements to processes and apparatus for treating ores containing sulphides. Nichols Copper Co. 710,988, 2/10/31.
Process for the electrolytic extraction of zinc. L. Cambi, *et al.*, 711,029, 2/11/-31.
High-speed steel. E. Becker, 711,059, 2/12/31.
Improvements to alloys of palladium and rhodium, and process for producing them electrolytically. Precious Metals Development Co., 711,081, 2/12/31.
Process for preventing surface decarburization in annealing or other heat treatment, especially of steel. Fagersta Bruks AB., Addition 39,109 (1st addition to 690,203, 2/15/30), 6/6/30.
Improvements to upsetting or forging machines. Omes Holding Co., Ltd., 710,823, 2/9/31.
Process for making seamless tubes of steel and other metals. Timken Holding & Development Co., 710,865, 1/20/30.
Process for making spiral-seam pipe and machine for working this process. T. M. A. Stewart, 711,079, 2/12/31.
Improvements in the mounting of wire-drawing dies made of special alloys. Cie. Générale des Filières en Diamant, 711,090, 2/13/31.
Machine for the impact testing of metals. A. Plana, 710,853, 2/12/31.
Anode for electrolysis. C. Conradty Fabrik Elektrischer & Galvanischer Kohlen, 711,024, 2/11/31.
Carbon electrode with graphite core. Same patentee, 711,075, 2/12/31.
Vertically displaceable furnace door. O. Poli, 710,888, 1/20/31.
Process for the production of pure metals. I. G. Farbenindustrie Akt.-Ges., 711,305, 2/14/31.
Process and machine for machining rolls, especially grooved rolls of pilger mills. Mannesmannröhren-Werke, 711,321, 2/14/31.
Process for covering iron or steel objects with aluminum or aluminum alloys. F. Nilsson, 711,364, 2/16/31.
Automatic arc welding machine. Soc. An. de Anciens Etablissements Achard et Cie., 711,149, 5/14/30.
Electrode equalizing system for automatic arc welding machines. R. Sarazin, 711,317, 2/14/31.
Thermo-electric pyrometer. La Pyrometrie Industrielle, 711,173, 5/17/30.
Improvements to electric heating apparatus, particularly to low- or medium-frequency induction furnaces. R. Dufour, 711,225, 1/24/31.
Process and automatically controlled apparatus for electrolytic deposition. A. Jacob, Addition 39,149 (1st addition to 683,888, 10/24/29), 10/6/30.
Improvements to hot tops for ingot molds. W. M. Charman, 711,509, 2/9/31.
Improvements to vertical furnaces for roasting clays or ores. A. Hirt, *et al.*, 711,631, 5/22/30.
Process for the production of zinc. Soc. L'Air Liquide, 711,652, 5/24/30.
Iron objects. I. G. Farbenindustrie Akt.-Ges., 711,392, 2/17/31.
Metal strip and process for making the same. The Cleveland Graphite Bronze Co., 711,466, 1/21/30.
Improvements to machines for making tubing. Soc. An. des Hauts Fourneaux et Fonderies de Pont-à-Mousson, 711,546, 2/18/31.
Optical pyrometer. Siemens & Halske Akt.-Ges., 711,506, 2/9/31.
Contact clamps for electric upsetting machines. S. A. Gatti & Giacchino, 711,-936, 2/24/31.
Process for nitriding metals. Electro Metallurgical Co., 711,747, 2/21/31.
Cementation process. Same patentee, 711,748, 2/21/31.
Process for cementation by nitriding. Same patentee, 711,749, 2/21/31.
Process for heat treating rails. Soc. An. d'Ougrée Marihaye, 711,815, 2/-23/31.
Process for treating ores. Sulphide Corp., 711,826, 5/31/30.
Improvements in the production of billets, sheet bars and the like. Timken Holding & Development Co., 711,850, 1/27/31.
Process for the centrifugal casting of cylindrical objects. Soc. An. des Anciens Etablissements Cochaux, 711,805, 2/23/31.
Apparatus for the surface hardening of the inner walls of hollow objects. F. Klopp, 711,824, 2/24/31.
Apparatus for making foundry molds and cores. G. Zimmermann, 711,845, 1/21/31.
Molding press for metals and non-metallic materials. E. Thieslack, 711,847, 1/22/31.
Improvements in the cleaning of metal sheets. Edward G. Budd Mfg. Co., 711,870, 2/5/31.
Pressure-casting machine. E. P. Fradin, 711,957, 5/31/30.
Machine for testing metals, particularly cast iron. Cie. Générale des Conduites d'Eau, 711,830, 8/4/30.
Process and device for mixing gas or vapor with molten materials, particularly metals or alloys. Blei & Silberhütte Braubach G. m. b. H., *et al.*, 712,354, 2/28/31.
Process for extracting iron and metals of the iron group. Vereinigte Stahlwerke Akt.-Ges., 712,363, 2/28/31.
Improvements to non-tarnishing silver and to the process for making it. Precious Metals Development Co., Inc., 712,431, 3/2/31.
Gold alloy, especially for jewelry. Soc. An. Cartier, 712,507, 6/14/30.
Aluminum alloys. Cie. de Produits Chimiques et Electrométallurgiques Alais, Froges et Camargue, 712,526, 6/17/30.
Treatment and production of lead and products made therefrom. P. Gamichon, 712,528, 712,544 & 712,554, 6/17/30, 6/18/30 & 6/19/30.
Process for working metals with the aid of electrically produced heat. W. Schabelitz, 712,370, 2/28/31.
Device for driving the pistons of die casting machines. Braunschweiger Hüttenwerk G. m. b. H., 712,421, 3/2/31.
Process for making foundry molds having an inner facing. The Metal Castings Holding Corp., 712,426, 3/2/31.
Process for making molded objects from powdered metals. I. G. Farbenindustrie Akt.-Ges., 712,462, 3/3/31.
Improvements to electric welders. L. Bourdelles, 712,552, 6/18/30.
Die. R. Charbonnier, 712,558, 6/19/30.
Draw press. L. Schuler Akt.-Ges., 712,576, 3/3/31.
Method of localizing electrolytic deposits of metal. Orfévrerie Christofle, Bouillet & Cie., 712,505, 6/14/30.
Method of mounting the housing rollers of blooming and plate mills. Schloemann Akt.-Ges., 712,672, 3/5/31.
Improvements to hard metal compositions and to processes for making the same. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, Additions 39,216 & 39,222 (8th & 9th additions to 654,210, 4/4/28), 7/31/30 & 8/29/30.
Improved aluminum alloy. Rolls-Royce Ltd., Additions 39,231, 39,234 & 39,235 (2nd, 3rd & 4th additions to 683,272, 10/14/29), 9/18/30, 9/-23/30 & 9/23/30.
Process for preparing cadmium from oxidic compounds of cadmium. Metallges. Akt.-Ges., Addition 39,269 (1st addition to 699,466, 10/24/29), 11/17/30.
Device for regulating the feed of the wire in automatic arc welding machines. Allgemeine Elektricitäts Ges., 712,631, 3/4/31.
Apparatus for hardening the outer surface of cylindrical objects. F. Klopp, 712,735, 3/6/31.
Electric welding machines. J. E. J. Languepin, Addition 39,259 (1st addition to 695,066, 8/13/29), 11/12/30.
Improvements in the nitriding of ferrous alloys. Electro Metallurgical Co., 712,749, 3/6/31.
Process and means for obtaining a uniform circulation of the bath in converters. K. Thomas, *et al.*, 712,793, 12/8/30.
Device for transferring rolled bars from runways to a cooling bed. Demag Akt.-Ges., 712,985, 3/10/31.
Device for moving several rolled bars through the runway leading to the cooling bed. Demag Akt.-Ges., 712,986, 3/10/31.
Process for obtaining gray cast iron of predetermined composition, in the cupola. Soc. Alsacienne de Constructions à Mulhouse, *et al.*, 713,023, 3/11/31.
Process for regenerating corroded metallic coatings. Durener Metallwerk Akt.-Ges., 712,753, 3/6/31.
Metal-drawing press. Scovill Mfg. Co., 712,785, 4/26/30.
Die-casting mold. Braunschweiger Hüttenwerk G. m. b. H., 712,934 & 712,935, 3/9/31.
Device for clamping molds for the die casting of bearings or the like. Same patentee, 712,936, 3/9/31.
Improvements in the drawing of metals. Electro Metallurgical Co., 712,937, 3/9/31.
Multiple purpose wrench for autogenous welding stations. H. Labbe, 712,989, 3/10/31.
Induction furnace. Siemens & Halske Akt.-Ges., 712,915, 3/9/31.
Welding blowpipe. Allgemeine Elektricitäts-Ges., 712,767, 3/7/31.
Suspension of refractory blocks. L. Tournemaine, 712,828, 3/17/31.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process for separating metals from solutions. Metallraffinerie Berlin G. m. b. H., 531,377, 3/7/30.

Process for filtering light metals such as magnesium or aluminum and their alloys. British Maxium, Ltd., 531,378, 3/11/28; France 11/7/27.

High-frequency furnace for refining metals, alloys or metallic mixtures by volatilization of metallic constituents. Hüttenwerke Trotha Akt.-Ges., 531,506, 5/1/27.

Process for smelting zinciferous material. The New Jersey Zinc Co., 531,379, 7/26/27; U. S. 1/27/27.

Process for separating zinc from iron. Soc. d'Electrochimie, d'Electrométallurgie et des Aciéres Electriques d'Ugine, 531,380, 8/6/29; France 6/22/29.

Deoxidizing metals and alloys. W. Reitmeister, 531,507, 6/17/28.

Bearing metal alloy. (Lead base.) Th. Goldschmidt Akt.-Ges., 531,631 (Addition to 408,229), 12/28/21.

Process for the electrolytic separation of copper from copper iodide solutions. Asociacion de Productores de Yodo de Chile, 531,530, 10/30/28.

Process and means for forming metallic coatings, especially on wires. Allgemeine Elektricitäts-Ges., 531,648, 5/3/30.

Device for lead-coating iron, copper or other pipes. O. Semmler, 531,649, 20/27/29.

Process for improving wooden objects by metal spraying. E. von Mallitz, 531,391, 7/18/30.

Process and device for the uniform spraying of plates, particularly for etching metal printing plates. F. A. Henrici, 531,533, 2/25/30.

Device for converting lead and lead oxides into lead dust. H. Heinicke, 531,392, 7/23/29.

Wire cooling device for slipless multiple wire-drawing machines. W. Nacken, 531,885, 9/9/30.

Mechanically driven tubing extrusion press. F. Singer, 531,962 (addition to 520,289), 12/6/27.

Process for making armored lead pipe. F. Barmé, 531,771, 8/6/30.

Device for closing the tap holes of metallurgical furnaces, particularly blast furnaces. Vereinigte Stahlwerke Akt.-Ges., 531,721, 10/29/30.

Method of heating open-hearth furnaces with coke oven gas. W. Heiligenstaedt, 532,008, 4/13/28.

Electric arc welding device. Allgemeine Elektricitäts-Ges., 531,737, 6/13/29.

Cut-off device for the hot gases from cupolas. F. Schinke, 531,982, 8/27/30.

Core molding machine. Maschinenfabrik Gritzner Akt.-Ges., 531,983, 6/11/30.

Jolt molding machine. Giessereibedarf G. m. b. H., 531,781, 10/17/26.

Process and machine for making hollow bodies by centrifugal casting. Vereinigte Stahlwerke Akt.-Ges., 531,839, 11/1/29.

Casting mold which can be rotated about a vertical axis. J. C. Davis, 531,953, 3/17/23.

Casting machine. R. H. V. Christensen, 528,610, 2/14/29; Denmark 2/29/28 & France 10/9/28.

Process for producing aluminum having high electrical conductivity and great strength. J. Hanco, 531,693, 4/9/29; Belgium 2/19/29.

Process for improving the mechanical properties of aluminum alloys containing copper. Metallges. Akt.-Ges., 531,782, 3/20/24.

Process and device for electroplating large objects in sections, especially with chromium. Siemens & Halske Akt.-Ges., 531,757, 6/20/29; U. S. 6/26/28.

Method of heating tunnel furnaces electrically. Hirsch, Kupfer & Messingwerke Akt.-Ges., 532,000, 11/20/29; Great Britain 11/21/28.

Process for preparing metal blanks for drawing and the like. N. Bregger, 532,244, 12/2/30; Austria 10/17/30.

Process for making iron alloys. I. G. Farbenindustrie Akt.-Ges., 532,409, 6/1/28.

Device for heat treating rock drills. Worthington Pump & Machinery Corp., 532,126, 5/29/26.

Drying oven for foundries. H. Küppers, 532,332 (Addition to 530,985), 1/17/28.

Electrically heated drying oven for foundry cores and the like. E. F. Russ, 532,380, 10/20/29.

Closure for core boxes. W. Freytag, 532,265, 6/26/30.

Method of and device for molding sink basins. Maschinen- u. Werkzeugfabrik Kabel Vogel & Schemann Akt.-Ges., 532,266, 12/25/30.

Process for making approximately pipeless castings from induction furnace charges, and devices used therein. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 532,520, 9/7/26.

Seal for water-cooled centrifugal casting molds. Buderus'sche Eisenwerke, 532,333, 12/5/30.

Process for the simultaneous production of two or more castings by centrifugal casting. G. Pemetzrieder, 532,334 (Addition to 528,881), 4/18/30.

Process for making clean cut castings of refractory metal alloys, such as tungsten carbide. A. Brennecke, 532,169, 10/8/25.

Process and device for making cylinder linings and pistons. T. R. Pawlikowski, 532,267, 3/29/29.

Production of metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 532,534, 3/17/29.

Interchangeable tuyère for cupolas. R. Stotz, *et al.*, 532,710, 7/24/30.

Screening device, particularly for preparing molding sand. Royer Foundry & Machine Co., 532,807, 4/20/30.

Mold for casting the housings of cylinder locks. Firma Albert Küppersbuch, 532,775, 7/1/28.

Process for making bearings. Ges. für elektrische Unternehmungen Ludw. Loewe & Co. Akt.-Ges., 532,808 (Addition to 512,434), 11/2/30.

Press for making steel flasks from seamless pipes. Hütten G. m. b. H., 533,332, 10/13/29.

Process for making a wheel from sheet metal. Budd Wheel Co., 533,124, 2/7/29; U. S. 3/21/28.

Process for diminishing or practically stopping the corrosive action of gases and dilute solutions containing hydrochloric acid on silicon-rich iron alloys. I. G. Farbenindustrie Akt.-Ges., 533,105, 7/9/26.

Carburizing apparatus. The Singer Mfg. Co., 532,882, 9/28/28; U. S. 10/3/27.

Joint between a metal and the metallized surface of a ceramic object. Siemens-Schuckertwerke Akt.-Ges., 533,147 (Addition to 512,976), 5/17/29; U. S. 11/9/28.

Internally heated electric annealing or heating furnace. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 533,448, 1/24/28.

Electric induction furnace. Associated Electrical Industries, Ltd., 533,449, 10/2/29; Great Britain 10/9/28.

Ironless induction furnace. H. Kamps, *et al.*, 533,450, 3/3/29.

Method of butt-welding railroad rails by the electric fusion welding process. Allgemeine Elektricitäts-Ges., 533,149, 8/12/30.

Wire-feed device for electric arc welding machines. Same patentee, 533,150, 1/12/29.

Device for spraying liquids on to ingot molds. W. Schwarz, 532,895, 4/20/30.

Installation for preparing molding sand. M. Chrobog, 533,279, 2/18/28.

Cast car-wheel disk. N. Leonard, 533,280, 12/15/28.

Device for making cores for bearings. Metallges. Akt.-Ges., 532,896, 2/3/27.

Method and device for ejecting bolts from chill molds. O. Junker, 533,281, 8/16/30.

Process for roasting ores in rotary tubular furnaces. Metallges. Akt.-Ges., 532,899, 10/6/28.

Production of metallic tungsten. I. G. Farbenindustrie Akt.-Ges., 532,991, 1/1/30.

Process for the electrolytic production of pure aluminum from alloys of aluminum with less electropositive components. Cie. de Produits Chimiques et Electrométallurgiques Alais, Froges et Carmargue, 533,374, 4/24/28; France 11/9/27.

Process for making electrolytic iron. E. Kelsen, 533,113, 2/9/29; Austria 2/16/28.

Heat treatment of metals and alloys in fused baths containing oxidizable substances. Deutsche Gold- u. Silberscheideanstalt, 532,900, 12/6/29.

Production of high-grade copper alloys. Vereinigte Deutsche Metallwerke Akt.-Ges., 532,992 (Addition to 531,304), 5/13/26.

Process for making very brilliant bronzing powder. E. Oeser, 533,179, 5/8/29.

Process for heat treating sheet metal having a metallic coating. H. Neuhauss, 533,180, 10/26/29.

Method of working rolled material which is to be cold drawn. R. W. Moll, *et al.*, 533,182, 11/28/29.

Production of pipes with internally thickened ends by upsetting. Mannesmannröhrenwerke Akt.-Ges., 532,919, 3/20/30.

Forging machine. O. Georg, 533,410, 3/4/30.

Machine for bending and hardening leaf springs. P. Hobracht, 533,238, 12/15/27.

Device for straightening shafts. Firma Carl Hurth, 532,921, 3/2/30.

Method of brazing hard-metal tips or edges onto steel tools. B. Reinhardt, 533,025, 8/18/29.

Solder. G. Frunhübner, 533,026, 12/30/28.

Soldering iron. A. Weigend, 532,922, 7/6/30.

Process for making cranks and crankshafts which are free from piping and segregation. F. W. Nierhaus, 533,027, 3/16/29.

Strip mill for rolling thin metal strip. Siemens & Halske Akt.-Ges., 533,771, 4/18/29.

Means for braking the device for shifting the rod of pilger mills. E. Röber. 533,682 (Addition to 518,505), 5/17/30.

Rolling mill installation for making seamless pipe. E. Röber, 533,683, 6/5/30.

Liquid brake for the shift rod of pilger rolling mills. E. Röber, 533,684, 3/22/30.

Cylindrical roll with curvilinear concave section. P. Damiron, 533,685, 8/21/29.

Coupling spindle for driving the top roll of rolling mills. Schloemann Akt.-Ges., 533,686, 6/26/30.

Adjusting mechanism for cold rolling mills. W. Bauer, 533,687, 6/28/30.

Runway for cooling beds. F. Klein, 533,662, 2/20/29.

Device for stretching iron bars arriving on a cooling bed. Demag Akt.-Ges., 533,933, 8/28/28.

Entrance-side press for strip mills and auxiliary machines used in the production of metal strip. F. Krupp Grusonwerk Akt.-Ges., 533,934, 7/9/30.

Plate straightening machine. Hydraulik G. m. b. H., 533,663, 5/7/29.

Method of joining pipes to each other and to connections by welding. A. Siebeck, 533,586, 5/16/26.

Means for roughening the surface of a welding electrode which is to be provided with a coating by rolling. Firma Franz H. Stromberg, 533,688, 9/8/29.

Process for making alloys. I. G. Farbenindustrie Akt.-Ges., 533,952, 1/13/27.

Process for forming metallic coatings on elements made of non-conducting oxides, for the indirectly heated cathodes of electric discharge tubes. Allgemeine Elektricitäts-Ges., 533,792, 3/8/27.

Electric melting furnace with roof heating. R. Gautschi, 533,616, 12/3/30.

Arrangement of laminated iron casings for current-carrying coils. Allmänna Svenska Elektriska AB., 533,489, 5/19/29; Sweden 7/16/28.

Means for controlling the power factor of inductively loaded alternating current circuits. Hirsch, Kupfer- u. Messingwerke Akt.-Ges., 533,490, 2/19/28; U. S. 2/25/27.

Induction furnace. Siemens & Halske Akt.-Ges., 533,794, 7/3/26.

Joining electric furnace electrodes. Siemens-Planiawerke Akt.-Ges. für Kohlefabrikate, 533,491, 6/2/27.

Means for automatic regulation of the electrodes of electric furnaces. Cie. des Forges et Aciéries de la Marine & d'Homécourt, 533,492, 12/30/27; France 1/14/27.

Means for utilizing the heat of melting furnaces. Vereinigte Stahlwerke Akt.-Ges., 533,869, 2/1/30.

Method and device for operating cupolas. F. Schinke, 533,922, 11/13/29.

Process and device for making lined melting crucibles. American Machine & Foundry Co., 533,879, 7/19/29.

Process for roasting pyrites. H. Koppers Akt.-Ges., 533,634, 9/25/29.

Reduction of raw materials mixed with solid fuels in rotary tubular furnaces. F. Krupp Grusonwerk Akt.-Ges., 534,011, 4/19/28.

Aluminum alloys which can be improved by thermal and mechanical treatment. Vereinigte Aluminiumwerke Akt.-Ges., 533,635, 8/17/23.

Process for improving aluminum alloys containing up to about 8% zinc. O. Tiedemann, 533,674, 3/5/24.

Method of cooling copper and copper alloy sheet and wire. Akt.-Ges. Brown, Boveri & Cie., 533,636 (Addition to 512,173), 10/15/26.

Process for forming a rust-preventive coating on iron and steel. R. Auerbach, *et al.*, 533,579, 4/8/28.

Process for forming coatings on electrically conducting wire, filaments, strips and the like. Patent-Treuhand-Ges. für elektrische Glühlampen, 533,644, 4/16/30.

Furnace for the simultaneous production of a plurality of soldered joints. Deutsche Industrie-Werke Akt.-Ges., 533,764, 2/2/30.

Process for making heat-exchanging elements, especially out of rustproof steel. F. Krupp Akt.-Ges., 534,014, 8/9/29.

Copying device, especially for torch cutting machines. C. Krebs, 533,995, 4/12/30.

Process for rolling thin, narrow, straight-fibered strips. Heraeus-Vacuumschmelze Akt.-Ges., *et al.*, 534,296, 11/26/29.

Rolling process for making carding wire, starting with round wire. W. Vesper, 534,454, 6/3/28.

Mandrel for tube-rolling mills. Vereinigte Stahlwerke Akt.-Ges., 534,112, 5/22/30.

Electrical control device for the auxiliary machinery of rolling mills. Schloemann Akt.-Ges., 534,208, 1/17/31.

Roller bed with two or more runways placed side by side. F. Krupp Grusonwerk Akt.-Ges., 534,696 (Addition to 491,870), 5/16/30.

Machine for stacking sheets, chiefly for rolling mills. The Bonnot Co., 534,-546, 8/30/29; U. S. 9/19/28.

Cooling device for drawing dies. O. Diener, 534,380, 4/5/30.

Wire-drawing machine. Electrical Research Products, Inc., 534,381, 8/5/27.

Tongs for draw benches. Sundwiger Eisenhütte-Maschinenbau-Akt.-Ges., 534,382, 9/24/30.

Coiling or uncoiling device for strip material. K. Christian, 534,383, 11/-21/30.

Process for making pipes out of sheet metal. K. Breitenbach, 534,547, 1/-19/28.

Extrusion press. Schloemann Akt.-Ges., 534,384, 3/21/30.

Mandrel and plunger guide for horizontal extrusion presses for metals. Adolf Kreuser G. m. b. H., 534,632, 6/17/28.

Mechanically driven extrusion press. F. Singer, 534,633 (Addition to 531,-294), 12/6/27.

Lead-cable press. Hydraulik G. m. b. H., 534,385, 1/6/31.

Tube push bench. Demag Akt.-Ges., 534,386 & 534,387, 2/21/30 & 6/27/30.

Device for corrugating quadrangular tubes for sub-chambered boilers. Press- u. Walzwerk Akt.-Ges., 534,388, 7/4/30.

Process for making finned tubing. Bundy Tubing Co., 534,389, 6/14/28; U. S. 6/20/27.

Tool for making sections out of iron strip. Metallwarenfabrik Wilhelm Schade G. m. b. H., 534,281, 6/15/29.

Rolling mill for rolling rings, particularly car-wheel tires. Adolf Kreuser G. m. b. H., 534,113, 10/21/28.

Process for making carbon electrodes. E. Szarvasy, 534,550, 11/16/26.

Device for removing and carrying off blast-furnace throat dust. Vereinigte Stahlwerke Akt.-Ges., 534,313, 1/29/29.

Sand seal between the throat closure and shaft of blast furnaces. Kölsch-Fölzer-Werke Akt.-Ges., 534,651, 1/31/31.

Process for producing iron. W. Doht, 534,314, 3/15/30.

Process for welding packs of iron or other metals. F. E. Menne, 534,284, 10/28/26.

Cooling device for the door frames of tilting open-hearth furnaces. A. Hütten, 534,285, 8/4/29.

Annealing muffle. Heraeus-Vacuumschmelze Akt.-Ges., 534,623, 5/7/27.

Joint between a metal coating on the oxide layer of a rectifier plate and the conducting lead to the plate. Siemens-Schuckertwerke Akt.-Ges., 534,137, 2/28/29.

Device for soldering seams with a soldering iron connected in the secondary circuit of a transformer. 534,324 (Addition to 523,462), 11/5/30.

High-frequency furnace for heating non-conducting or poorly conducting materials. E. J. Kohlmeyer, 534,492, 4/6/29.

Rotary forehearth for cupolas. Gewerkschaft Zuversicht VIII, 534,575, 6/3/30.

Process for working up preheated materials which give off volatile metals when heated strongly in a furnace. F. Krupp Grusonwerk Akt.-Ges., 534,094, 7/17/27.

Utilization of aluminum-chromium alloys. K. Schmidt G. m. b. H., 534,376, 6/8/24.

Continuous striking mechanism. Meier & Weichelt, 534,156, 4/2/30.

Fatigue testing machine. Schumag Schumacher Metallwerke Akt.-Ges., 534,157, 4/26/29.

Fatigue bending machine for the simultaneous testing of several similar specimens. Maschinenfabrik Augsburg-Nürnberg Akt.-Ges., 534,675, 8/-27/30.

Method of determining the direction and magnitude of the surface stresses in structural elements. Maybach-Motorenbau G. m. b. H., 534,158, 12/-21/26.

Device for producing sheets and tubing (by electroforming). E. Kelsen, 534,602, 6/22/29; Austria 6/27/28.

Machine for branning or degreasing tin plate. S. Davies, 534,603, 3/12/29; Great Britain 9/5/28.

Process for lead-coating metal objects. American Machine & Foundry Co., 534,604, 7/5/28.

Process for converting molten metals, salts and the like into products having a uniform granular, especially spheroidal form. I. G. Farbenindustrie Akt.-Ges., 534,681, 2/13/30.

Swedish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Electric resistance welding apparatus. F. H. Leslie, 72,495, 4/9/26, Priority date 4/11/25.

Combined electric heat-radiation and charge-resistance furnace. A/S per Kure, Norske Motor & Dynamofabrik, 72,496, 6/20/28.

Holder for electric furnace electrodes. Siemens-Planiawerke Akt.-Ges. für Kohlefabrikate, 72,497, 12/15/28, Priority date 5/4/28.

Electric spot welding device. Allgemeine Elektricitäts Ges., 72,299, 9/20/29, Priority date 10/3/28.

Process for making plates and fittings for use in cellulose manufacture, and elements thus produced. J. Härdén, 72,509, 4/12/29.

Process and device for casting molten metal under pressure. R. H. V. Christensen, 72,615, 2/1/29, Priority dates 2/29/28 & 10/9/28.

Method of protecting metals against corrosion during treatment with pickling or coating agents. C. F. Boehringer & Söhne G. m. b. H., 72,624, 5/19/30, Priority date 5/21/29.

Means for rotating gears which are being hardened inside hardening boxes. F. Klopp, 72,607, 11/21/29.

Process for providing printing plates or printing surfaces with a surface which is easily separable from the matrix. Internationale Tiefdruck G. m. b. H., 72,623, 5/7/30.

Process for the production of metals and metallic compounds. A. S. Burman, *et al.*, 72,643, 6/25/29.

Process for freeing aluminum-bearing material from iron and other substances. A. S. Burman, *et al.*, 72,644, 11/11/29.

Process for producing metallic compounds or metals. A. S. Burman, *et al.*, 72,645, 2/17/30.

Process for producing metalloids or metalloidal or metallic compounds in the form of rods. V. Kjellgren, 72,659, 5/17/27.

Process and machine for expanding metal tubing. Mannesmannröhren-Werke, 72,685, 6/30/27.

Process for making wrought iron. A. M. Byers Co., 72,694, 6/19/29, Priority date 7/19/28.

Process for treating pyrite ores. S. I. Levy, *et al.*, 72,709, 2/28/30.

Fusion electrolysis process. J. B. Stålhane, 72,710, 1/16/30.

Current lead-in device for electric furnace electrodes. Norske A/S for elektrokemisk Industri, 72,752, 9/21/26, Priority dates 9/30/25 & 12/9/25.

Heat recuperator with refractory hollow blocks. K. Kniepert, 72,803, 1/31/30; Priority date 2/13/29.

Iron alloy. B. D. Saklatwalla, 72,804, 5/4/28; Priority date 6/30/27.

Means for protecting water-cooled mercury rectifiers made of iron, against corrosion. Fusi Denki Seizo K.K., 72,816, 2/7/30; Priority date 2/27/30.

Electric induction furnace. Finspongs Metallverk AB., 72,817, 10/20/27.

Process for protecting magnesium and its alloys against corrosion by hot baths of fused salts. I. G. Farbenindustrie Akt.-Ges., 72,827, 11/15/30; Priority date 12/11/29.

Process for producing pure alumina. Zaidan Hojin Rikagu Kenkayujo, 72,857, 7/11/27.

Process for reducing ores without melting. A. Johnson & Co., 72,860, 12/-10/28.

Method of operating mechanical roasting furnaces and devices used therewith. A. V. Carlson, 72,877, 4/25/27.

Process for producing alkali metals by fusion electrolysis. J. B. Stålhane, 72,878, 2/4/30.

Process for pickling metals. J. H. Gravell, 72,884, 3/27/28; Priority date 3/29/27.

Process for producing iron from iron-bearing ores. Vereinigte Stahlwerke Akt.-Ges., 72,900, 1/20/28; Priority date 2/7/27.

Two-piece chaplet. E. Sonnet, 72,971, 8/2/29.

Process for producing zinc. H. E. Coley, 72,974, 1/10/28; Priority date 2/2/27.

Process and machine for making welded tubing, especially precision tubing. Vereinigte Oberschlesische Hüttenwerke Akt.-Ges., 73,005, 1/21/30; Priority date 2/1/29.

Swiss Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Method and means for connecting and disconnecting condensers in high-frequency circuits, especially those supplying induction furnaces. Allgemeine Elektricitäts Gesellschaft, 146,699, 3/8/30; Germany 3/13/29.

Zinc alloy. The New Jersey Zinc Co., 146,911, 8/23/29; U. S. 3/12/29.

Process for preparing magnesium. L. Friedrich, 146,912, 4/16/20.

Device for winding thin metal strip on tubular reels. W. Bauer, 146,913, 2/-6/30.

Device for driving coiling reels for cold rolling mills. W. Bauer, 146,914, 2/-6/30.

Device for straightening strips to be cold rolled. W. Bauer, 146,915, 2/6/30.

Process for improving the corrosion resistance of aluminum sheet and strip. Vereinigte Silberhammerwerke Hetzel & Co., 146,916, 4/7/30.

Process for aluminothermic welding. Elektro Thermit G. m. b. H., 146,917, 3/21/30; Germany 4/17/29.

Welding machine. Ford Motor Co., Ltd., 146,918, 5/22/30; U. S. 5/25/29.

Process for making coated metal strip. The Cold Metal Process Co., 146,919, 2/19/30; U. S. 12/19/29.

Process for cleaning and brightening the surface of metals. The Bullard Co., 147,172, 3/24/30.

Method and instrument for determining high temperatures. K. Weisert, 147,-191, 5/27/30.

Process for preparing permanent molds for casting magnesium and magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 147,205, 7/15/30; Germany 8/10/29.

Drive for template-guided tools. A. Schmidt, 147,206, 4/4/30; Austria 4/-9/29, 9/11/29 & 11/17/29.

Electric welding machine. Ford Motor Co., Ltd., 147,207, 6/12/30; U. S. 6/20/29.

Plate straightening machine. F. Ungerer, 147,208, 7/23/29.

Method of charging a closed electric electrode furnace. P. L. J. Miguet, *et al.*, 147,272, 10/17/29; France 12/6/28.

Salt-bath furnace. Siemens-Schuckertwerke Akt.-Ges., 147,273, 7/11/30; Germany 8/24/29.

Process for metallizing objects of organic origin by means of metal vapor. K. Richter, 147,473, 6/2/30.

Process for improving the mechanical properties and structure of aluminum-silicon alloy castings. Aluminium-Industrie Akt.-Ges., 147,516, 3/-11/30.

Process for soldering metal parts. N. V. Philips' Gloeilampenfabrieken, 147,517, 3/28/30; Netherlands 4/27/29.

Process for dispersion hardening of shaped object, particularly castings of magnesium alloys. I. G. Farbenindustrie Akt.-Ges., 147,522, 3/11/30; Germany 4/25/29.

Process for improving the mechanical properties of magnesium alloys. Same patentee, 147,523, 5/19/30; Germany 6/29/29.

Process for coloring metal foil. Folien Akt.-Ges. Arbon, 147,530, 2/5/30.

Magnetizable pulverized-metal core. Hartstoff-Metall Akt.-Ges. Hametag, 147,589, 4/9/30.

Protective device for electric furnace electrodes. Siemens & Halske Akt.-Ges., 147,596, 4/22/30; Germany 5/31/29.

Process for making carbon electrodes for electric furnaces. Siemens Planiawerke Akt.-Ges. für Kohlefabrikate, 147,597, 5/17/30; Germany 11/-23/29.

Process for forming aluminum coatings on metals. Aluminium Industrie Akt.-Ges., 147,807, 7/9/30; Germany 8/24/29.

Machine for casting curved stereotype plates. Wood Newspaper Machinery Corp., 147,813, 7/25/29.

Process for refining magnesium-cerium alloys. I. G. Farbenindustrie Akt.-Ges., 147,862, 3/13/30; Germany 4/15/29.

Process for making gas- and oxide-free ingots and castings. A. Godefroid, 147,863, 7/7/30.

Process for making metal shapes. H. Seiferth, 147,864, 5/19/30; Germany 6/27/29.

Welding or soldering flux, particularly for aluminum, and process for making the same. O. Asal, 147,865, 5/16/30.

Process for making tools. F. Krupp Akt.-Ges., 147,866, 6/10/30; Germany 11/6/29.

Soldering flux for aluminum, copper, brass, iron, etc. F. Badertscher, 147,867, 12/31/30.

Process for making products having improved properties out of magnesium and its alloys. I. G. Farbenindustrie Akt.-Ges., 147,868, 1/25/30; Germany 3/11/29.

Process for making shapes having uniform wall thickness out of strips of sheet metal. Same patentee, 147,869, 9/6/29; Germany 10/3/29.

Process for making vessels of polyhedral shape, such as ice cells, out of tough metallic material. F. Krupp Akt.-Ges., 147,870, 5/30/30; Germany 6/6/29.

Surface-hardened shaft journal. Deutsche Edelstahlwerke Akt.-Ges., 147,-872, 5/9/30; Germany 5/14/29.

Process for bright-annealing metals in an electric annealing furnace. Siemens-Schuckertwerke Akt.-Ges., 147,938, 8/15/30; Germany 12/21/29.

Patent attorney, chemical engineer, now in charge of patent department Eastern manufacturer, offers part time services to firm or corporation. Box PA1, Metals & Alloys, 3619 Forbes St., Pittsburgh, Pa.

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MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

1101 **Steel.**—The Hawkridge Brothers Company is prepared to furnish steel of every description and has issued a stock list showing the sizes in which it is possible to obtain their tool steels, spring steels, cold drawn steels and special purpose steels.

1102 **Finishing Compounds.**—The Carborundum Company, Niagara Falls, N. Y., has directed its research and resources toward the development of a suitable finishing compound and also to a close study of proper applications and the procuring of scientifically correct results. The result of this research is presented in a booklet prepared by them.

1103 **Welding Rod.**—Bronze welding is generally used to unite parts made of cast iron, malleable iron and steel, but it may be applied to almost all commercial metals, ferrous and non-ferrous. Revere Copper and Brass Inc., New York, have issued a booklet telling about their Roman Bronze welding rod, and illustrating some of its uses.

1104 **Heat and Corrosion Resistant Alloys.**—An attractive pamphlet has recently been sent out by the Michiana Products Corporation, Michigan City, Ind., which gives technical data on their "fire armor," "Zorite," "No. 48 alloy" and "Nirosta alloys." The physical properties of each of these are given and conditions under which its use is suitable.

1105 **Nitralloy.**—A leaflet prepared by The Nitralloy Corporation, 230 Park Ave., New York City, gives a partial list of reported successful applications for Nitralloy.

1106 **Heat Treating Containers.**—The Rezistal Lite-Wate heat-treating containers are lighter in weight, which makes possible a lower operating cost and a reduction in fuel costs. The Pressed Steel Co., Wilkes-Barre, Pa., have sent out two leaflets describing and illustrating these containers.

1107 **Die Steel.**—A new type of high-carbon-high chromium die steel has been developed by the Firth-Sterling Steel Co., 410 New Park Ave., Hartford, Conn. They have called it "Cromovan" triple die steel and have compiled a booklet describing its special properties, giving the heat treatment recommended for it and method to be used when pack hardening.

1108 **Screw Steel.**—Union Supercut, a new screw steel, is a product of the Bessemer converter, and of very similar analysis to Bessemer Steel. It is said to have superior machining qualities and exceptional finished parts. A small booklet sent out by the Union Drawn Steel Co., Beaver Falls, Pa., reproduces set-up sheets which represent actual results obtained in plants.

1109 **Potentiometer Pyrometer.**—A new booklet issued by the Brown Instrument Company, Philadelphia, Pa., explains and illustrates the principal features of their new potentiometer pyrometer with special reference to accuracy of operation and ruggedness in service.

1110 **Stainless Steels.**—An attrative black and silver broadside sent out by the Illinois Steel and Carnegie Steel Companies lists a number of typical uses for their products.

1111 **Chemicals.**—The Dow Chemical Co., Midland, Mich., has issued a leaflet containing a list of the chemicals prepared by them.

1112 **Electric Furnaces.**—The various types of electric furnaces manufactured by the General Electric Co., Schenectady, N. Y., are illustrated and described in a twenty-four page book prepared by them.

1113 **Welded Steel Gears.**—The research department of Lukenweld, Inc., has prepared a pamphlet on "Welded Steel Gears from Blanks of Lukenweld Construction" which shows the development of these gears and their special properties.

1114 **Fahrite.**—An interesting booklet with this title describes the plan of the Ohio Steel Foundry Company, Springfield, Ohio, and illustrates castings for a variety of industries. Fahrite alloy castings are said to be immune to the action of high sulphur gases and the fumes of zinc, lead, antimony or any other products of ordinary roasting operations.

1115 **Nitriding.**—Bulletin 950 of the Leeds & Northrup Co., Philadelphia, Pa., describes the Homo method applied to nitriding of steel and shows typical installations of their furnaces. A price list is included.

1116 **Steel-Service.**—Joseph T. Ryerson & Son, Inc., Chicago, Ill., will cut heavy plates and billets in any irregular shape or size and have recently sent out a bulletin illustrating some of the unusual forms and shapes they have cut.

1117 **81 Years of Iron and Steel.**—An interesting little booklet has been issued by the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. It gives a short historical sketch of the company and has many illustrations of the various departments and plants of the company.

1118 **Ludlum Products.**—The various products of the Ludlum Steel Company, Watervliet, N. Y., are listed in a bulletin sent out by the company lately.

1119 **Electric Melting Pots.**—Bulletin TC-11 of the Harold E. Trent Co., Philadelphia, Pa., is a catalog of their electric melting pots for melting Babbitt, solder, tin type metal and lead for continuous service and temperatures up to 1000° F.

1120 **Coloring Copper and Brass.**—The Copper & Brass Research Association, New York City, has issued a small bulletin containing a few simple formulae for cleaning and coloring copper and brass. The formulae are ones which have been widely used.

1121 **Lead.**—The September issue of this publication of the Lead Industries Association, Graybar Bldg., New York, N. Y., features several interesting and unusual uses of lead.

1122 **Heat Treating Furnaces.**—Leaflet No. 295 sent out by the W. S Rockwell Co., 50 Church St., New York City, illustrates their heat-treating and carburizing furnaces of the enclosed front type for annealing, hardening, normalizing, drawing, etc. These may be either fuel or electric fired.

1123 **Strain Gage.**—The Tuckerman optical strain gage for the precise measurement of tension and compression strains in hot and cold metal specimens and for the testing of riveted joints is discussed in a pamphlet sent out by the American Instrument Co., Inc., 774 Girard St., N. W., Washington, D. C.

1124 **Arc Welders.**—General Electric Company leaflet GEA-1440 is devoted to their arc welders, both portable and stationary. A number of these are described and some suggestions for their operation are given. The leaflet is punched for binding in the G-E folder. Other leaflets by the same company are: GEA-1450, Mechanical-Drive Turbines; GEA-137B, Low-Speed Synchronous Motors; GEA-1406, Single-Phase Motors.

1125 **High Speed Steel.**—A new booklet of the Firth-Sterling Steel Company discusses two of their high speed steels—Circle C and Blue Chip. Each of these is discussed at length and performance data are included. There are also some recommendations as to heat treatment.

1126 **Pot Furnaces.**—Bulletin No. 10 of the American Electric Furnace Company of Boston is devoted to their cylindrical type pot furnaces for lead, salt and cyanide. A cross section diagram of one of the furnaces is shown.

1127 **Welding.**—The September issue of Oxy-Acetylene Tips, published by the Linde Air Products Co., 30 East 42nd St., New York City, features an article on the use of welding for pipe line construction.

1128 **Dowmetal.**—This is the name which identifies magnesium alloys developed and manufactured by the Dow Chemical Company, Midland, Mich., and they have recently sent out a small booklet which gives the properties and applications of these alloys.

1129 **Plating Rolled Zinc and Zinc Die Castings.**—A research bulletin issued by the New Jersey Zinc Company, 160 Front St., N. Y., assembles the information necessary for the practical plating of rolled zinc and die cast zinc parts. It is also possible to obtain a chart giving the procedure in diagrammatic form.

1130 **Sturaco.**—Bulletin No. 2 published by the D. A. Stuart & Co., Chicago, Ill., gives the development of their gear lubricant, "Sturaco." It is fully illustrated.

1131 **Furnace Control.**—Circulars introducing the Isley furnace control with automatic reversing and perfect regulation for all types of regenerative furnaces have been sent out by the Morgan Construction Co., Worcester, Mass.

1132 **Testing.**—A leaflet sent out by the American Instrument Co., Inc., Washington, D. C., describes a method for the study of the casting qualities of metals which was developed at the Bureau of Standards.

1133 **Compressors.**—The Spencer Turbine Co., Hartford, Conn., has prepared a pamphlet describing their slow speed compressors. A cross-section of one of the compressors is shown and charts giving performance data are included.

1134 **Arc Welding.**—Bulletin GEA-995B of the General Electric Company, Schenectady, N. Y., is a 40-page booklet devoted to arc welding in industry. Applications of welding to industrial uses are discussed and profusely illustrated. Bulletin GEA-1477 gives characteristics of the new G-E arc welders.

1135 **Metals and Alloys.**—A leaflet listing their products and describing their service has just been issued by the Electro Metallurgical Company, 30 East 42nd St., New York, N. Y.

1136 **Conveyor Belts.**—A new loose-leaf handbook describing in detail the various types of metal conveyor belts for high and low temperatures has been prepared by the Wickwire Spencer Steel Co., 41 East 42nd St., New York, N. Y. The company plans to issue new pages on additional features that are added to their line.

1137 **Furnaces.**—Bulletin No. 296 of the W. S. Rockwell Co., 50 Church St., New York, N. Y., describes their rotary carburizing furnaces, both electric and fuel fired. Their bulletin No. 289 discusses their counterflow and straight line type continuous furnaces.

1138 **Industrial Machinery.**—Machinery for tumbling, separating, cleaning, washing, burnishing, painting or pickling metal parts is illustrated in a recent catalog of the Ideal Industrial Machinery, Winton Place, Cincinnati, Ohio.

1139 **Drilling.**—Whitman & Barnes, Inc., Detroit, Mich., have sent out several leaflets lately. One of these is "How to Drill High Manganese Steel" and others describe their high speed drills, their wire drills and their interchangeable punches and retainers.

1140 **Copper and Brass Products.**—Many copper, brass and bronze products are listed in the July 1, 1931 catalog of Revere Copper and Brass, Inc., 230 Park Ave., New York, N. Y. Prices are included.

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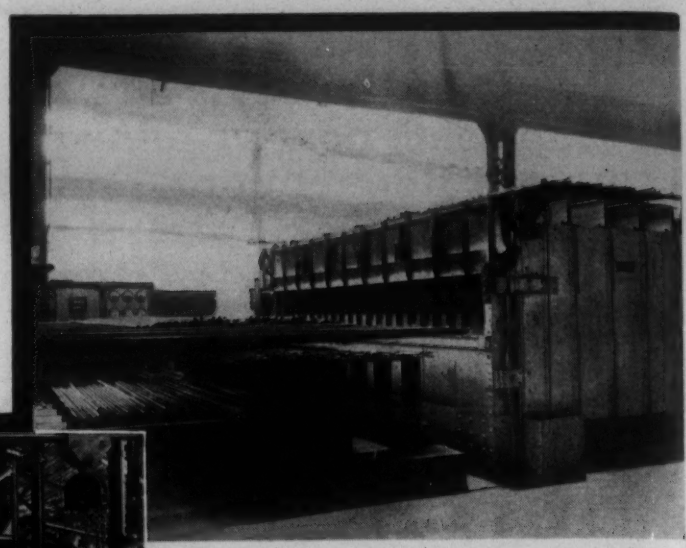

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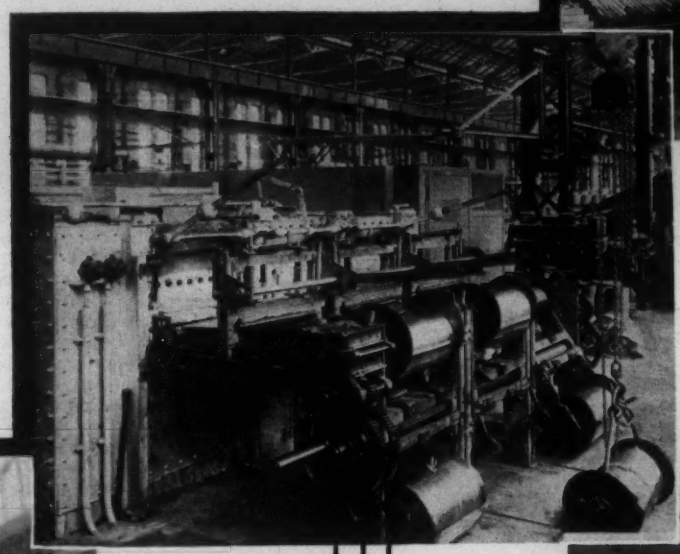

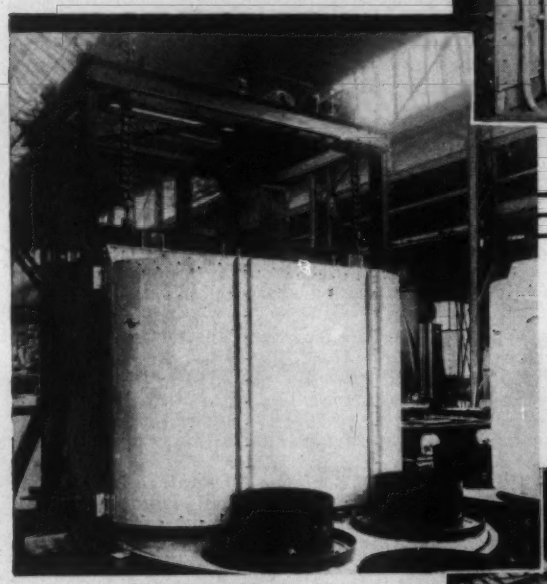

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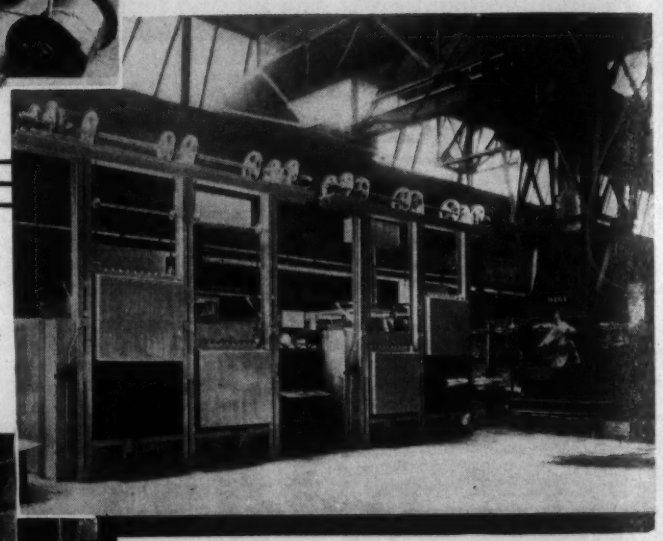

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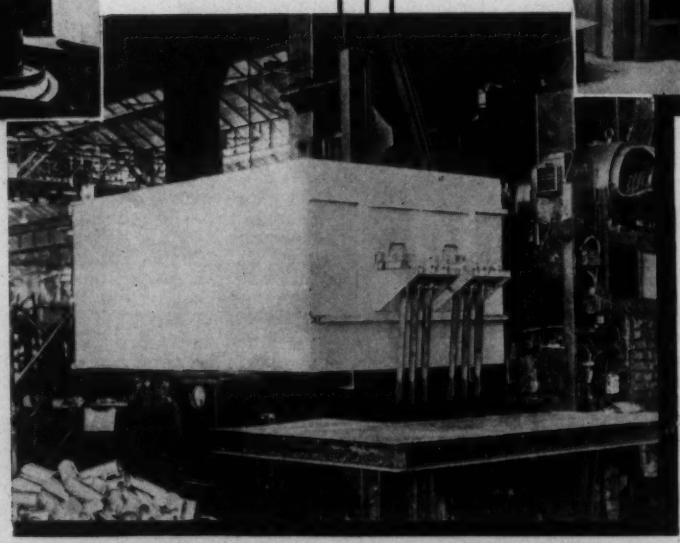

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METALLURGICAL ABSTRACTS

A digest of the important metallurgical developments of the world

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METALLURGICAL ABSTRACTS, incorporated in METALS & ALLOYS, is the most complete review of metallurgical literature (periodicals, books, etc.) available. Sixty section editors and abstractors cover over 400 domestic and foreign publications and abstract the articles on metallurgical engineering as well as allied subjects.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform with our style they are classified. The section editors edit the abstracts appearing in the section in which their major interest lies.

There are usually at least two places where an abstract might fit, sometimes even more, and so we decide who will be most interested in the article. We want the abstracts to be so arranged that if a heat treater reads only Section 10 he will keep in touch with all the important articles in his field and if a foundryman will read Section 22 each month he will not miss anything important. An improvement we hope to make in the METALLURGICAL ABSTRACTS in the near future is the cross-indexing of articles, which belong under several sections. Some of the sections are descriptive and some are self-explanatory and we have so labeled them.

CLASSIFICATIONS

0 (General). Under this heading we classify all abstracts which are of interest to the metallurgical industry in general. Compare this with Section 20—miscellaneous.

1, 2, 3 (Properties of Metals, Non-Ferrous and Ferrous Alloys). An article goes under one of these heads when the properties are emphasized and not the method of determining them.

4 (Corrosion, Erosion, Oxidation, Passivity & Protection of Metals & Alloys). This takes articles on weather resistance, resistance to acids, etc., and protection against them.

5a (Structure of Metals & Alloys—Metallography & Macrography). An article would go in this group if it discussed the microscopic or macroscopic study of metals and alloys, or the determination of constitutional diagrams, critical points, etc.

5b (Structure of Metals & Alloys—Structure and X-Ray Analysis). This group includes articles dealing with the structure of metals and alloys as determined by X-ray analysis and X-ray examination.

6 (Physical, Mechanical & Magnetic Testing). If an article emphasizes the method of determining the properties of metals rather than the properties them-

selves it belongs in this section. The abstracts on fatigue appearing under this section are prepared with the coöperation of the Fatigue Research Committee of the American Society for Testing Materials.

7a (Electro-Chemistry—Electroplating). This will include articles on the electrolytic plating of metals.

7b (Electro-Chemistry—Electrometallurgy). This relates to the electrolytic recovery and refining of metals.

8 (Metallic Coatings Other than Electroplating). Articles on galvanizing, metal spraying or dip coating would come in this group.

9 (Industrial Uses and Applications). If the application of the metal is stressed rather than the properties the article belongs in this section.

10 (Heat Treatment). If heat treatment in general is discussed the article would be classed under section 10; if, however, any distinct operation is stressed it would go under the corresponding subhead.

11 (Joining of Metals and Alloys). The explanation for this group is similar to that for section 10.

12 (Working of Metals & Alloys). We feel that the divisions in this group are self-explanatory to men in the metals industries. We might say, though, that an article is classified under 12j (Cold Working) only when it will not fit under one of the other heads—for instance, an article on cold rolling would be put under 12c, rolling.

13 (Defects). This section includes articles dealing with inclusions, segregations, cracks, pinholes, blowholes and failures.

14 (Chemical Analysis). If the method of analysis is emphasized the article goes here.

15 (Historical & Biographical). Self-explanatory.

16 (Economic). Articles in this group are devoted to economic trends, savings, cost estimates, etc.

17 (Plants & Laboratories) This section includes descriptive articles.

18 (Machinery & Supplies). This includes descriptive articles.

19 (Bibliographies). Self-explanatory.

20 (Miscellaneous). This takes in all scattered articles which do not belong anywhere else.

21 (Laboratory Apparatus). Purely descriptive articles belong here. If results or processes are given they would go under 6 or 14.

22 (Foundry Practice & Appliances). This is self-explanatory.

23 (Furnaces & Fuels). This takes in descriptive articles. Otherwise they go under 10, heat treating, 10b, annealing, etc.

24 (Refractories & Furnace Materials). This section is hand-in-hand with 23. Furnace men should read both of them.

25 (Gases in Metals). This is self-explanatory.

26 (Inspection). This includes articles dealing with inspection, pure and simple—not X-ray or microscopic analysis.

27 (Effects of Elements on Metals and Alloys). Articles dealing with the effect of the addition of different chemical elements to metals and alloys are included in this group.

28 (Instruments & Controllers). Descriptive.

29 (Effect of Temperature on Metals and Alloys). This section is prepared in conjunction with the Joint High Temperature Committee of the A. S. T. M. and the A. S. M. E.

30 (Leaching). Self-explanatory.

31 (Reduction Metallurgy). This would include articles on blast furnace practice.

32 (Non-metallic Coatings for Metals and Alloys). Articles discussing painting, enameling, lacquering, etc., belong here.

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It has been our purpose in this outline to make our scheme of classification apparent to our readers and so, perhaps, make the abstract section more useful. If you have any questions pertaining in any way to the abstracts, write to us. We shall be glad to answer them in detail.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

PROPERTIES OF METALS (1)

Change in the Electrical Resistance of Nickel Wire on Straining at Raised Temperature. (Veränderung des Widerstandes von Nickeldraht beim Spannen mit gleichzeitiger Erwärmung.) S. ARZIBYSCHEW & W. J. U. JUSCHAKOW. *Zeitschrift für Physik*, Vol. 64, 1930, pages 405–410.

Measurements of the electrical resistance of a nickel wire subjected to tensile stress show that stress at first causes a decrease of electrical resistance and that the value progressively decreases to a minimum and subsequently commences to rise. The effect produced varies with temperature and disappears entirely at the Curie point. It is, therefore, considered that the change in electrical resistance of the strained nickel wire is definitely associated with its ferromagnetic properties. Ha(1)

The Isotopic Constitution and Atomic Weights of Selenium, Bromine, Boron, Tungsten, Antimony, Osmium, Ruthenium, Tellurium, Germanium, Rhenium and Chlorine. F. W. ASTON. *Proceedings of the Royal Society*, Vol. A-132, Aug. 1931, pages 487–498.

Amended Table of Isotopes

Element	Atomic Weight	Atomic Number	Minimum Number of Isotopes	Mass numbers of isotopes in order of abundance
Ru	101.7	44	7	102, 101, 104, 100, 99, 96, 98
Te	127.5	52	4	128, 130, 126, 125
W	184.0	74	4	184, 186, 182, 183
Re	186.31	75	2	187, 185
Os	190.8	76	6	192, 190, 189, 188, 186, 187

WAT(1)

Cold Working Properties of Tantalum. M. M. AUSTIN. *Metal Stampings*, Vol. 3, Mar. 1930, pages 247–248.

See *Metals & Alloys*, Vol. 2, June 1931, page 109. (1)

The Magnetization of Nickel Wire under Severe Tensile Stress. (Die Magnetisierung von Nickeldraht unter starkem Zug.) R. BECKER & M. KERSTEN. *Zeitschrift für Physik*, Vol. 64, 1930, pages 660–681.

The influence of elastic distortion on magnetic susceptibility has been quantitatively determined on samples of nickel wire subjected to severe tensile stress. The results are presented in detail, and theoretically discussed. Ha(1)

The Annealing of Hard Conductor Aluminum. (Ueber das Anlassen von hartem Leitaluminium.) H. BOHNER. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July–Aug. 1931, pages 280–283.

The effect of different annealing temperatures and annealing times on tensile strength and electric conductivity of hard drawn Al wires of at least 99.5% purity is investigated and is compared with the results of other investigations on less pure Al. It can be stated that, as a practical result, a conductivity of 36 ohms/m./mm.^{2} at 20° C. can be obtained easily with a tensile strength of 18 kg./mm.^{2} Ha(1)

On the Toxicity of Aluminum as Compared with Iron, Nickel and Other Metals. (Sur la toxicité de l'aluminium, comparée á celle du nickel et d'autres métaux.) GEGRIEL BERTRAND & P. SERBESCU. *Comptes Rendus*, Vol. 193, July 20, 1931, pages 128–131.

As the result of experiments with cooking vessels of various metals, the authors arrived at the conclusion that, in the absence of proof to the contrary, it seems that the fear of the noxious action of small quantities of Al artificially introduced in alimentary substances has no foundation—at least so long as the quantities remain of an order similar to those which exist in the normal state in the tissues of animals and plants. OWE(1)

Preparation of Pure Cerium. (Préparation of cérium pur.) MAURICE BILLY & FELIX TROMBE. *Comptes Rendus*, Vol. 193, Sept. 7, 1931, pages 421–423.

An electrolytic method of producing Ce is described, the bath being composed of cerium chloride, potassium chloride and calcium fluoride in suitable proportions. The bath is maintained at a temperature of 850° C. and the Ce deposited contains only traces of Si. The following properties are quoted for the metal: Brinell hardness (250 kg., 5 mm. ball), 42.5; density, 6.75; melting point, 815 ± 5° C. OWE(1)

On the Magnetic Properties of Metals (Copper, Silver and Alkali Group). FRANCIS BITTER. *Physical Review*, Vol. 36, Series 2, 1931, pages 978–983.

The magnetic susceptibility of Cu and Ag is affected by structure factors; annealing increases the diamagnetism and drawing decreases it. The Ag used in the experiments was pure and diamagnetic but the Cu was slightly paramagnetic owing to impurity, and became more paramagnetic on drawing. The wide divergencies between the published figures for the susceptibility of the alkali metals are pointed out, and may be due to structure effects. The specific susceptibility of Li is measured as 3.8×10^{-6}. There is a wide discrepancy between the observed susceptibilities of the alkali metals and those calculated for the free electrons by the Pauli theory, together with the diamagnetic contributions of the ions, and it is suggested that the effects of partly bound electrons should be considered. 13 references. Ha(1)

The Resistance of Ferro-Magnetic Metals as a Function of Temperature. (Die Temperaturabhängigkeit des Widerstandes ferromagnetischer Metalle.) G. BORELIUS. *Annalen der Physik*, Vol. 8, No. 3, 1931, pages 261–266.

On the basis of the relations already discovered between resistance and spontaneous magnetization, it is shown (using nickel as an example) that the electric resistance of a ferromagnetic metal can be considered to be the sum of a normal temperature resistance and an additional resistance which is a function of the magnetization. Ha(1)

The Constitution of the Cadmium-Rich Alloys of the System Cadmium–Silver. P. J. DURRANT. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 99–118 (with discussion); abstracts in *Engineer*, Vol. 151, Mar. 20, 1931, page 328; *Engineering*, Vol. 131, Mar. 20, 1931, page 382.

Paper read before the Institute of Metals, Mar. 11, 1931. See *Metals & Alloys*, Vol. 2, May 1931, page 97. LFM(1)

Compressibility and Pressure Coefficient of Resistance, Including Single Crystal Magnesium. P. W. BRIDGMAN. *Proceedings American Academy Arts & Sciences*, Vol. 66, Mar. 1931, pages 255–271.

Measurements of compressibility at 30° and 75° C. are reported on 10 materials. All except metallic Mg crystallize in the cubic system so that measurements were made on crystal aggregates. Mg crystallizes in the hexagonal system and single crystals were prepared and the compressibility was measured parallel and perpendicular to the axis. The materials measured were NaF, BaF_2, SrF_2, CdF_2, AlSb, CdTe, HgTe, TiN, TiC and Mg. The effect of pressure on the electric resistance was measured for TiN, TiC and Mg. Ha(1)

Note on Theory of Internal Friction in Metals. E. M. HORSBURGH. *Transactions Institution Engineers and Shipbuilders in Scotland*, Vol. 72, Yearbook 1929, pages 496–509.

A mathematical expression of the stresses occurring in metals as they approach failure. Tensile and compressive stresses are masked by shear and sliding. Internal friction in metals assists them to resist failure. WHB(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Properties of Rolled and Drawn Silicon-Manganese-Copper Alloys. E. VOCE. *Rolling Mill Journal*, Vol. 5, Jan. 1931, page 26.

Paper presented to the British Institute of Metals. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 899. JN(2)

Crystallization Experiments under 20,000 Atmospheres Pressure. (Kristallisationsversuche bei Drucken bis zu 20,000 Atmosphären.) GEORG WELTER. *Metallwirtschaft*, Vol. 10, June 12, 1931, pages 475–481.

Contains 5 references. A series of Al alloys were melted and poured in a metal mold which was placed into a hydraulic press. While the alloy was solidifying, pressure of 12,000 to 20,000 atmospheres was applied to the top of the metal. By this process the tensile strength was increased 30 to 40% over alloys cast in metal molds without pressure. The elongation, hardness and specific gravity were also considerably increased. Macrographs of the fracture and photomicrographs of the structure of the alloys cast with and without pressure are given to show the very much smaller crystals formed under pressure. They have the appearance of heat treated alloy steel, and are entirely free from porosity, cracks and segregations. Tests made with and without an asbestos lining around the mold gave identical results proving that the increase in strength was due to pressure and not quicker cooling. A series of Al alloys containing 13 to 21% Si was cast under pressures of 2000 to 20,000 atmospheres and examined microscopically. It was found that the eutectic, which under ordinary pressure is at 12% Si, was changed to 15% at 12,000–13,000 atmospheres and to 17–18% at 18,000–20,000 atmospheres. At 12,000 atmospheres the solid solution contained 3% Si against 1.5% at ordinary pressure. Test bars of three alloys subjected to 9000 atmospheres in a bath of molten lead at 550° C. showed no increase in strength or hardness. CEM(2)

Three Lectures on Dental Alloys. WALTER ROSENHAIN. Dental Board of the United Kingdom, London. Cloth, 6 × 9½ inches, 72 pages. Price 5 shillings.

Three lectures by Dr. Rosenhain arranged by the Dental Board to further post-graduate study, and delivered in 1926, were brought together into one volume. The object which has been kept in view has been not so much to give detailed information, but rather to show what important results must follow when modern metallurgical methods are applied to the particular metals and alloys employed in dental practice.

The first lecture, pages 1 to 26, deals with the structure and constitution of pure metals and alloys in quite an elementary manner. Microphotographs have been used abundantly to illustrate typical structural phases. Binary and ternary equilibrium diagrams are developed to illustrate systems common to alloys of definite dental interest.

In the second lecture, pages 27 to 56, the physical properties of the gold-silver-copper alloys, the silver and tin amalgams, the silver-tin alloys and the silver-tin-mercury alloys are discussed more elaborately. The investigations on the amalgams and silver-tin alloys have been carried out more or less completely at the National Physical Laboratory.

The lecturer throws doubt on the interpretation and accuracy of the silver-tin-mercury system as given by Joyner and Knight. The behavior of silver-tin filings on aging is discussed and two possible explanations for the setting of amalgams are offered. An interesting description is given of the method used by the National Physical Laboratory for studying the structure and constitution of mercury and amalgams.

The third lecture, pages 57 to 72, covers the treatment of metals and alloys by casting, rolling, pressing and swaging. The importance of removing gases from molten metal, the plasticity of metals and the effect of cold work and heat-treatment on the crystal structure of dental alloys are given considerable attention.—C. H. Lorig (2)-B-

Properties of Lead-Bismuth, Lead-Tin, Type Metal and Fusible Alloys. J. G. THOMPSON. *Metal Industry*, London, Vol. 39, July 3, 1931, pages 7–10, July 10, 1931, pages 33–34.

Condensed from Research Paper No. 248 of the U. S Bureau of Standards. The tensile properties and hardness of the above four types of lead alloys are given. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 29. PRK(2)

Nickel-Copper Alloys of High Elastic Limit. D. G. JONES, L. B. PFEIL & W. T. GRIFFITHS (Mond Nickel Co.). *Institute of Metals, Advance Copy* No. 573, Sept. 1931, 18 pages.

Alloys containing up to 50% Ni were tested. In preparing the alloys small quantities of Mn, Si and Mg were added as "deoxidizers." Low elastic-limit or proportional-limit values were obtained in both annealed and cold rolled alloys. A high elastic limit could be produced by any of the following 3 methods: (1) annealing the cold rolled alloy at a low temperature (400–550° C.); (2) adding Si to the alloy in a quantity dependent on the Cu-Ni ratio and hardening by quenching from 800–900° C. and aging at 500–550° C.; (3) combination of the first 2 methods. As an example of the properties produced by this last treatment, an 80–20 Cu-Ni alloy containing 0.17% Si and 1.26% Mn cooled rapidly from 900° C., cold worked to a reduction of 50% and reheated to 550° C. for 1 hour had the following tensile properties: 42.2 tons/in.^{2} tensile strength, 27.6 tons/in.^{2} elastic limit and an elongation in 2 in. of 21%. 2 references. JLG(2)

Studies on Light Alloys. (Contributo alla conoscenza di alcune leghe leggere.) LUIGI LOSANA. *L'Industria Chimica*, Vol. 5, Feb. 1930, pages 145–150.

The coefficient of thermal expansion, heat conductivity, and specific heat at various temperatures of a number of Al-Si, and Al-Mg alloys have been measured. The equilibrium curves are shown. The following conclusions are drawn: the coefficient of expansion of Al-Si alloys up to 500° decreases with increasing Si; Mg-Al alloys show a similar decrease with increasing Al; the heat conductivity of Al-Si alloys decreases with increasing Si, a very large drop is noted with 0–1% Si; Mg-Al alloys show decreases when small amounts of Al are added to Mg and vice versa, with a sudden jump at about 55% Mg, corresponding to Al_2Mg_3 (electrical conductivity shows a similar phenomenon); specific heats decrease rapidly with increased Si, while with Mg-Al, there is a rapid drop with increased Al up to 20% Al, then increases slowly to 60% Mg, then drops gradually. This maximum is most noticeable at lower temperatures. WHB(2)

The Alloys of Aluminum. (Les alliages d'aluminium.) H. GODFROID. *La Revue de Fonderie Moderne*, Vol. 24, Sept. 10, 1930, pages 301–302, 315–318 343–346.

The use of light alloys and their advantages over steel, their classification and the physical properties of Cu, Al, Mg, Ca and Na are given. The production and properties of Al and the properties of its alloys with Cu and other metals; Zn, Sn, Mg, Ni and Ti, are described. The design of molds suitable for Al alloy casting, the use of special Al alloys, and a comparison of the mechanical and electrical properties of commercial Al-Cu and Al steels are discussed. (2)

Some Properties of Some Alloys of Precious Metals. (Proprietá delle leghe da Oreficeria.) ADELAIDE LABO. *L' Industria Chimica*, Vol. 5, May 1930, pages 571–573.

The composition, hardness and tensile strength of gold from 9–22 carats is given. WHB(2)

Age-hardening Copper-titanium Alloys. F. R. Hensel & E. I. Larsen. *American Institute Mining & Metallurgical Engineers, Technical Publication*, No. 432, Sept. 1931, 11 pages.

Cu-Ti alloys containing up to 25% Ti were prepared. Those containing 5% or less Ti could be forged. The Cu-rich portion of the diagram was investigated by thermal and X-ray methods. A eutectic between the solid solution and Ti or a compound is located between 20 and 27% Ti. X-ray examination showed that the Cu lattice expanded with the addition of Ti. The solubility limits of Ti in Cu vary from 0.4% at room temperature to about 4 or 4.5% at the eutectic temperature. Alloys in this range are age-hardenable. The tensile strength of a quenched 2.58% Ti alloy increased from 54,000 to 104,000 lb./in.^{2} on aging 8 hr. at 400° C. Its elongation in 2 in. fell from 37.7 to 16.7%. The electric resistance decreases on aging. Contains 3 references. JLG(2)

Conductivity of Aluminum Silicon Alloys. (Leitfähigkeit von Aluminium-Siliciumlegierungen.) W. Fraenkel & R. Hahn. *Metallwirtschaft*, Vol. 10, Aug. 14, 1931, pages 643–644.

The range of alloys examined contained from 0 to 15% Si and were prepared partly with American 99.95% pure Al, partly with technical 99.7% Al. Conductivity was determined in the quenched at 500° and aged at 300° condition. Conductivity is higher in the aged condition. The angle in the curve of the quenched alloys points to the solid solubility of about 1.5% Si in Al at 550°. In samples made with pure Al, the Si appears to separate faster than when traces of Fe are present. Si practically does not conduct current at all. CEM(2)

Studies of Commercial Cast Alloys. (Untersuchungen an technischen Gusslegierungen.) O. Bauer & O. Vogel. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 51–83, 85 figs.

Test castings of a cast 90 : 10 phosphor bronze, of cast brass 2 : 1 brass, of silumin and elektron were made according to commercial practice, in 5 cross sections ranging from 1 to 10 cm. The bars were upright cylinders cast on a common base block by bottom pouring; one lot of elektron was also cast horizontally in keel-block bars. Each material was cast by 2 firms so that check observations were made in each series. These were subjected to very extensive studies for chemical segregation, structure, hardness, density and porosity along the length and cross-section. The results show wide variation in porosity which was greater where freezing was slower. The keel-block elektron castings were sound. On the largest bronze casting the Brinell varied as widely as from 57 to 91, the brass from 43 to 55, the silumin from 42 to 50 and the elektron from 54 to 63. Marked differences in density were found in all and chemical segregation was notable in the bronze and brass. The authors conclude that to give a real picture of the true properties of a casting, extremely extensive examination is required, that different alloys demand different methods of casting and that in practice, far too little attention is paid to these matters. As an object lesson to show that one test on a cast specimen may be far from showing its true properties, the article is a very telling one. HWG(2)

Cadmium in High Lead Bearing Metals. (Ueber das Kadmium in Hochbleilagermetallen.) K. L. Ackermann. *Metallwirtschaft*, Vol. 10, July 24, 1931, pages 593–597.

Contains 9 references. This investigation was undertaken to determine whether cadmium additions to lead base bearing metals would be of any value. The alloys examined included Pb-Sb-Cd, Pb-Sb-Sn-Cd, Sb-Cu-Cd, Pb-Sb-Sn-Cu-Cd and Pb-Sb-Sn-Ni-Cd. Hardness, elastic limit, impact, compression and frictional tests were made. 22 photomicrographs show the structures obtained and several constitutional diagrams are given. Only alloys with more than 5% Sb and less than 4% Cd can be considered. With less Sb they are too soft and with more Cd too brittle. When Cd is substituted entirely for Sn the alloys become softer; when it is partly substituted they become harder. All Pb-Sb-Cd and Pb-Sb-Sn-Cd alloys have lower elastic limits and impact strength than the corresponding alloys without Cd. While Cd is closely related to Sn chemically, it forms long needles of CdSb in Pb base bearing metals. Cu and Ni, when present, form Cu_2Sb and Ni_2Sb_3 and do not form compounds with Cd. The hardness of Pb base alloys containing Cu or Ni is raised slightly by additions of Cd over .6%, but lowered considerably when Cd is partly or completely substituted for Sn. The elastic limit and impact strength are lowered by Cd additions. Friction is also increased by Cd additions. The conclusion is that Cd additions are not beneficial. CEM(2)

Some Properties of Silicon—"Aluminium—Bronzes." L. J. Brice. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 209–228 (includes discussion); *Engineering*, Vol. 131, Mar. 27, 1931, page 410.

Paper read before the Institute of Metals, Mar. 12, 1931. See *Metals & Alloys*, Vol. 2, May 1931, page 94. LFM(2)

Thermionic Emission of Oxide-Coated Cathodes Containing a Nickel-Barium Alloy Core. N. C. Beese. *Physical Review*, Vol. 36, Series 2, 1930, pages 1309–1313.

The thermionic emission from filaments coated with Ba and Sr oxides is appreciably increased by using an alloy of Ni with 0.15% Ba as the base metal instead of pure Ni. The effect is particularly marked with thin coatings of oxide. On prolonged heat treatment at a high temperature (1300° C.), the Ba evaporates and the increased activity is lost which shows that the effect is due to the nature of the metal core. Ha(2)

Experiments to Increase the Electric Conductivity of Hard Conductor Aluminum by Thermal Treatment. (Versuche zur Erhöhung der elektrischen Leitfähigkeit von hartem Leitaluminium durch thermische Behandlung.) H. Bohner. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July–Aug. 1931, pages 276–279.

The electrical conductivity of hard material, beside depending on the chemical composition of the Al, depends on the rolling temperature and can be increased considerably, independent of composition, by an intermediate annealing of the rolled wires at about 300° C. The tests and results are given in detail. 7 references. Ha(2)

Pewter and Its Manufacture. B. Egeberg. *Brass World*, Vol. 27, Aug. 1931, pages 177–179.

A description of the alloys, melting, rolling practice and peculiarities in heat treatment of pewter, reprinted from the "Monthly Review" of the American Electroplaters' Society. Variation in hardness at various temperatures is shown by a curve. Pewter is softened by cold work, but tests prove it is not weaker than the annealed metal. WHB(2)

The Alloys of Lanthanum. (Le leghe del lantanio.) G. Canneri. *La Metallurgia Italiana*, Vol. 23, Sept. 1931, pages 803–823, 34 illustrations.

Electrolytic lanthanum of m. p. 812° C., density at 20°, 6.153 was prepared by electrolysis of fused lanthanum and sodium chlorides. The purity of the lanthanum is given as 99.6%. The method of purification of the lanthum chloride is not discussed, nor is proof given of the absence of other rare earth metals though it is stated that the 0.4% of impurities consists of Si, Al, Mg and C. Cooling curves of alloys of La with Pb, Sn, Tl, Mg, Ag, Cu and Au were taken and tentative equilibrium diagrams constructed. Attempts to prepare alloys of La with Zn or Cd were not successful. With Pb, Sn, Tl and Au, very high melting compounds are formed, e. g., $PbLa_2$, m. p. 1318° C. and La_2Sn, m. p. 1425° C. The following compounds were indicated: Pb_2La, PbLa, $PbLa_2$; La_2Sn, La_3Sn_3, $LaSn_3$; Tl_3La, TlLa, $TlLa_2$; La_4Mg, LaMg, $LaMg_3$, $LaMg_4$; LaCu, $LaCu_2$, $LaCu_3$, $LaCu_4$; $LaAg_2$, $LaAg_3$, LaAg; $LaAu_3$, $LaAu_2$, LaAu, La_2Au. A few qualitative comments are made on the properties of the various alloys and micrographs of some are shown. HWG(2)

PROPERTIES OF FERROUS ALLOYS (3)

A Study of Some Properties of Structural Silicon Steels. (Étude de quelques proprietes des aciers de construction au silicium.) Tamura. *Revue de Métallurgie*, Vol. 28, July 1931, pages 405–416.

Three steels of low carbon silicon type (0.08% C, 0.33% Mn, 0.33–1.96% Si) and one structural silicon steel (0.13% C, 0.96% Mn, 0.96% Si) were studied. A_1 point rises slightly with increasing Si content; A_3 somewhat faster but with 1.96% Si the latter was not found up to the temperature of 1100°. The structure of normalized silicon steels is the same as of common steel but the grain size grows with the Si content. The resistance grows with Si at the rate of 12.1 microhms/cm.^{2}/cm./1% of Si. The permeability increases with Si with low inductions (B up to 14,500) and decreases afterward. The elastic limit and tensile strengths are increased for 1% Si by 3.5 and 7.3 kgs./mm.^{2} respectively but the elongation drops. Resilience, as well as corrosion resistance, diminishes rapidly as Si increases. Hardness increases after heat treatment directly proportionally to Si content. Structural steel of Si type has higher physicals than carbon steel of the same C content but it rusts much faster. The effect of aging is very weak in its case. JDG(3)

Low-carbon Steel. H. B. Pulsifer. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 426, Sept. 1931, 31 pages.

Frequency curves that show the irregular properties of unheat-treated bolts are given. A 0.10% C steel was quenched from various temperatures. A martensitic structure was formed on quenching from high temperatures (1800° F.). Irregular properties were found in commercially quenched cap screws, that were heated to about 1600° F. and dumped in water. Micrographs show the structures produced by various treatments. The properties of carburized steels are discussed. 18 references. JLG(3)

Alloy Cast Steel. (Legierter Stahlguss.) E. Kothny. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 31, 1931, pages 613–618; Aug. 7, 1931, pages 635–639.

A detailed discussion and analysis of properties and the application of Mn steel, Ni steel, Cr steel, Mo steel, Cr-W steel (especially for seamless pipes, with 0.7% C, 1.0% Cr and 2% W), Si steel, Cu alloyed steel. For details, the paper and the 27 references must be referred to. Ha(3)

The Combined Influence of Cold-Work and Finely Dispersed Precipitations upon Properties of a Metal. (Die Beeinflussung des Eigenschaftswertes eines Metalles durch Zusammenwirken von Kaltreckung und fein verteilten Ausscheidungen). W. Köster. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, pages 176–177.

The lecture delivered before the Deutsche Gesellschaft für Metallkunde, 1930, directs the attention to the changes of the coercive value of Fe-N-alloys due to cold work and to N segregations. The independence from the succession of the mechanical and heat treatment could be established and the decrease of the specific influence of the precipitation with rising amounts of deformations could be proved. EF(3)

The Machinability of Gray Iron as Dependent on the Content of Silicon. (Die Schneidfähigkeit von Grauguss in Abhängigkeit vom Silizium- und Kohlenstoffgehalt.) E. Diepschlag & Fr. Eggert. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 17, 1931, pages 313–318.

Investigation has proved that the common opinion that an increase of Si always gives an improvement in the workability is wrong. The contrary is true if the C does not amount to more than 4%. The C content largely determines the machinability; the higher it is, the lower are the cutting temperatures. An increase of Si seems to act favorably on the machinability only above 4% C. It is, therefore, disadvantageous to use high Si iron for normal castings which must later be machined by chipping tools if the C content does not amount to at least 4%. The high Si content only makes the castings more expensive without improving the machinability, and at less than 3.5% C the cutting temperatures are even noticeably increased. Test results are given in detail. Ha(3)

Effect of Degree of Rolling, Finishing Temperature and Heat Treatment upon the Mechanical Properties, the Sensibility toward Aging and the Structure of Plates. (Einfluss des Walzgrades, der Walzendtemperatur und der Wärmebehandlung auf die mechanischen Eigenschaften, die Alterungsempfindlichkeit und das Gefüge von Grobblechen.) F. Körber & K. Wallmann. *Stahl und Eisen*, Vol. 51, Apr. 16, 1931, pages 491–497.

The article is an abstract of the original publication in *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 13, 1930, pages 171–191. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 161. GN(3)

Comparative Investigation on Natural and Artificial (Aston) Wrought Iron. (Vergleichende Untersuchungen an natürlichem und künstlichem Schweisstahl (Aston-Eisen.) W. von Gutmann & H. Esser. *Stahl und Eisen*, Vol. 51, Sept. 24, 1931, pages 1193–1197.

After giving a general description of the Aston process, the authors report the results of comparative investigations on the structure and properties of wrought iron made by the old puddling process and the new Aston process. The chemical composition of both the wrought irons does not differ to a large extent. The C content of Aston wrought iron is always somewhat lower and the S content somewhat higher than that of puddled iron. The structures show no remarkable differences. Tests on red shortness and weldability give practically the same results. In segregation hardening, Aston wrought iron is inferior to puddled wrought iron which is undoubtedly due to the various C contents. The notch toughness of Aston iron is always somewhat higher than that of puddled iron. The tensile strength of Aston iron is somewhat lower and the elongation somewhat higher than those of puddled iron. Strain hardening tests indicate no differences between Aston iron, puddled iron, Armco iron and Krupp soft iron. Aston iron has a lower aging sensibility than puddled iron, Armco iron and Krupp iron. In corrosion tests, Aston iron shows some inferiority in comparison with the other irons mentioned. Aston iron satisfies all requirements which a good wrought iron must meet. But for unimportant details, puddled wrought iron and Aston wrought iron are completely alike. GN(3)

Austenitic Stainless Steel 18-8. (L'acier austénitique inoxydable; Cr 18-20, Ni 8-10.) J. Galibourg. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 173–179. 35 references.

General discussion of properties and uses. HWG(3)

Comparison of Annealed Nickel, Nickel Chromium and Carbon Steels. (Caractéristiques mécaniques des aciers au nickel, et au nickel chrome recuits, comparaison avec les aciers ordinaires.) J. Galibourg. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 157–171. 9 figures, 21 tables.

Tabulation of data from many sources, and its collection into curves. Composition is given in the tables, the curves are plotted on the basis of equal tensile strength. The relations between tensile strength and elastic limit, elongation and impact are shown for carbon steels as a base line for comparison. Ni raises the elastic limit and impact, elongation being of the same order as for carbon steels. Compared to the carbon steels, the Ni-Cr steels show a marked increase in elastic limit and some superiority in elongation the higher the tensile strength, while the minimum impact values are above the maximum values for carbon steels of the same tensile strength. HWG(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Acid Resisting Metals: A Few Comparative Tests. J. W. McMyn & V. Edge. *Chemistry & Industry*, Vol. 50, June 5, 1931, page 474.

Corrosion rates, as determined in test tubes, are given for "Staybrite" steel, "Monel" metal, "Batterium" metal, and copper in acetic acid, sulphuric acid, hydrochloric acid, sodium chloride, sodium carbonate, sodium hydrate, sodium hypochlorite and sodium sulphide solutions. PRK(4)

The Physical Chemistry of Corrosion Phenomena. (La chimica fisica dei ferromeni di corrosione.) F. Giordani. *Giornale di chimica industriale ed applicata*, Vol. 13, June 1931, pages 275–281.

A general résumé of the principles of corrosion, discussing passivity, the protective action of Cr in stainless steels, the analogy between the electrochemical behavior and the thermoionic phenomena of metals, inhibitors, differential aeration and especially the action of protective metallic coatings. It is pointed out that beside the position in the electromotive series, the hydrogen overvoltage of a metal under the conditions in which it is subjected to corrosion, has to be considered. A curve from the work of T. Maresca is given to show that the potential of Sn is less noble than that of Fe in fully acid or fully alkaline solutions, but that between about pH_2 and pH_{12} the positions are reversed. HWG(4)

Soil-Corrosion Studies, 1930. Rates of Corrosion and Pitting of Bare Ferrous Specimens. K. H. Logan & V. A. Grodsky. *Bureau of Standards Journal of Research*, Vol. 7, July 1931, pages 1–35.

Data on loss of weight and pitting of specimens of Bessemer steel, open-hearth steel, pure open-hearth iron, copper-bearing steel, wrought iron, sand-cast iron and DeLavaud cast iron, buried 8 years in 47 soils are given, and, for comparison, data obtained in each previous 2 year period. In general, the rate of attack decreases with time. Vast differences are shown in the corrosiveness of the different soils. Shorter and less extensive tests were made on malleable, on high tensile cast iron, on cast steel, and on high silicon cast iron (corrosion resistant type), and on 27% Cr, 0.2% steel. The last two materials were but slightly attacked. Of all the others, it is said: "the data so far obtained do not indicate that any one of the commonly used pipe materials is markedly superior to the others for general use underground." "If a soil is corrosive with respect to one ferrous material, it is corrosive with respect to the others also." "Other things being equal, the thicker the specimen, the lower will be its rate of deterioration if the test is continued until the puncture of the specimen occurs. This observation has a very practical application to the selection of the wall thickness of pipes which are exposed without protection to corrosive soils." HWG(4)

Resistance of Chromium Steel against Alkali Solutions. (Ueber die Widerstandsfähigkeit des Chromstahls gegen Alkalilösungen.) Albert Krüger. *Chemiker Zeitung*, Vol. 55, May 1931, page 335.

Preliminary tests indicate the suitability of vessels, crucibles, etc., made of Cr steel as a substitute for Pt vessels for the analytic determination of Fe, Al, Ni, if they are precipitated as hydroxides. Glass or porcelain vessels introduce serious errors under these conditions. Cr steel is also resistant against H_2O_2 and Na_2S in alkaline solutions. (4)

Use of Chemical Equipment Minimizes Corrosion in Textile Mills. Percy C. Kingsbury. *Textile World*, Vol. 80, Sept. 12, 1931, pages 26–27.

Stoneware containers and rolls and acid-resistant equipment for handling of corrosive materials used in bleaching and dyeing and finishing of textiles are described. Ha(4)

The Atrament-Process. (Das Atramentverfahren.) A. Karsten. *Oberflächentechnik*, Vol. 8, Sept. 15, 1931, pages 199–200.

The new process aims to provide a perfect protection against corrosion without, at the same time, changing the dimensions of the objects to be protected or their physical properties. It consists of a chemical change of the surface iron and steel parts by phosphoric salts of determined composition. The surface assumes, thereby, a pleasing, ebony black appearance. By further treatment, other colors can be obtained. It resists attacks of water, atmospheric and other influences. The parts must be free from grease, rust and oxides before being treated with atramentol. A short description of the bath and treatment of coloring is given. Atramentol is made by the I. G. Farbenindustrie A.-G., Frankfurt a.M. Ha(4)

Wool-Fat as Rust Protection. (Wollfett als Rostschutzmittel.) Freitag. *Oberflächentechnik*, Vol. 8, July 21, 1931, page 155.

Wool fat dissolved in tri-chloraethylen is recommended as a convenient and easily removable coating for temporary purposes such as rust protection during storage, etc. Ha(4)

Corrosion Reduction with Lime Treatment. Edw. S. Hopkins. *Water Works & Sewerage*, Vol. 78, July 1931, pages 191–192.

The corrosive effect of the soft water for the water supply of Baltimore, Md., was eliminated by the addition of lime which entirely absorbed the CO_2. The addition is automatically controlled by a Leeds and Northrup recording potentiometer. The cost of lime application amounted to 16c per million gals. of water pumped in 1930. The water leaving the plant contains only 0.03–0.10 parts per million of Fe. Ha(4)

Alloys Resistant to Heat and Sulphur. (Ueber hitze-und schwefelbeständige Legierungen.) H. Gruber. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 151–157.

The author places emphasis on the influence of the melting points of the various sulphides formed at the surface upon the sulphur stability. Furthermore the nature of the surface layer upon the progress of the attack was investigated. In addition to the rise of the melting points of the sulphides at the surface of Al, the formation of a gas tight oxide film is assumed. Besides melting point and density to gases, the importance of the thermal expansion is discussed. Experiments were carried out in an H_2S-atmosphere at 700°, 800°, 900° and 1000° C. and some 29 various alloys were employed. The analyses are given and refer to Fe-Ni-Cr alloys with additions of Mn, Al, Co, Mo and W. The tests resulted in the adoption of the following heat- and sulphur-resistant alloy which turned out best: 20% Fe, 61% Ni, 15% Cr, 4% Mn, 10% Al. EF(4)

Corrosion of Metal Hydroplanes. (Korrosion bei Metallwasserflugzeugen.) Guido Guidi. *Metallwirtschaft*, Vol. 10, Aug. 14, 1931, pages 645–646.

One reference. The most important effect of seawater on metals is of electro-chemical character, especially when in contact with 2 or more different metals. Immersion and spray tests are discussed. They can be evaluated by determining the loss in weight or loss in strength. Investigation of the potential difference between pairs of metals in electrolytes under various conditions show that there is a direct relation between the tendency to corrode and the electric currents. Agitation of the electrolyte increases the potential difference up to a certain point, beyond which no increase in potential difference or corrosion takes place. Protective measures include mechanical means, painting exposed parts, and electrochemical, by interposing a metallic layer. Alclad, Duralplat, stainless steels and Cd plating have been investigated by the potential difference method. CEM(4)

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The Corrosion Protection of Metal Oxide Coatings. (Korrosionsschutz von Metallen-Oxydische Ueberzuege.) E. LIEBREICH. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 29, 1931, pages 1110–1111.

This is a review of the modern methods of producing oxide coatings of metals by chemical treatment. This method provides a much better protection against corrosion (if their structure is good) in spite of the minute thickness of the oxide films than the protection by thicker coatings which are not so elastic and can, therefore, not follow expansions so easily and are more liable to cracking. These thin films are now often alloyed with other metals such as Ni, Cr, Mn, etc.; this increases the protective action. Several methods used for producing these films are described. Ha(4)

Corrosion of Tin Plate on the Inside of Preserving Tins. (La corrosion du Fer-Blanc a l'Intérieur des Boites de Conserves.) ED. LASAUSSE. *Chimie et Industrie*, Vol. 25, June 1931, pages 1348–1353.

Previous papers relating to the quantity of metal found in preserved products do not indicate the conditions under which the products were prepared, but only the length of time in which corrosion has occurred. Among the acids usually present in cans and capable of causing corrosion, the most active is acetic acid; it causes almost all the bulging found when the cans are opened. Fatty acids and citric acid attack the metal to the same degree, but only produce incomplete bulging. American authors note that tertiary amino acids can facilitate the dissolving of Sn. Conversely, we note that the introduction of sodium phosphate in the liquids in the tins definitely retards the corrosion. We think that a thin film of insoluble phosphate is formed which causes the retardation. MAB(4)

Soil-Corrosion Studies: Nonferrous Metals and Alloys, Metallic Coatings and Specially Prepared Ferrous Pipes Removed in 1930. K. H. LOGAN. *Bureau of Standards Journal of Research*, Vol. 7, Sept. 1931, pages 585–605; *Bureau of Standards Research Paper* No. 359.

The information concerning soils which has been obtained as the result of the bureau's soil-corrosion investigations makes it clear that the rate of corrosion of any metal exposed to soil can not be accurately expressed by a single figure or group of figures. On account of the variations found in all soils the influence of the character of the soil, differences in contact between the soil and the metal, changes in the supply of oxygen and moisture, and the effects of the corrosion products, the best that can be hoped for is an expression representing the average rate of loss of weight or pitting accompanied by a figure for the standard deviation, probable error, or some other expression indicating how much the behavior of any single specimen may be expected to differ from the behavior of the average of a representative group of specimens. Average values sufficiently accurate to show small differences in the performance of competing materials can only be secured through the testing of a very large number of specimens. Since in any one case any material may prove considerably better or worse than the average, it is doubtful whether the drawing of fine distinctions between materials would be of practical value except for the consumers of very large quantities of materials. Attention should, therefore, be directed chiefly to the unmistakable differences between different kinds of materials rather than to possible small differences between nearly similar materials. The most general conclusion to be drawn from the data is that for best results the material must be chosen to fit the soil in which it is to serve, since no one material is best for all soil conditions. Another general conclusion is that small differences in the data should not be considered significant, since it is improbable that a repetition of the test would yield identical results. In nearly all soils Cu and alloys high in Cu resist corrosion well. Muntz metal shows at least slight dezincification after 6 years burial in half of the soils investigated and serious dezincification in a few of them. In nearly all of the soils considered, Pb corroded much less rapidly than Fe or steel. The rates of pitting of commercial lead specimens were 3 mils/year or greater in 25% of the soils. The Pb containing Sb showed rates of pitting greater than 3 mils/year in nearly 50% of the test locations.

The outer metallic ribbon of the parkway cable showed corrosion in most test locations. The inner ribbon was somewhat less corroded. Serious pitting of the Pb sheath occurred only in the soil containing alkali carbonates. All of the metallic coatings tested appeared to increase the life of the material to which they were applied. Comparison of the effectiveness of the metallic coatings is difficult because they differed in thickness. All coatings showed evidences of deterioration in several soils. In most of the soils, there was no evidence that the rate of penetration by pitting increased after the lead coating had been punctured. The possibility is suggested that the relative positions of lead and iron in the electrochemical series depends upon the soil in which specimens composed of lead and iron are placed. The precision of the data is insufficient to show at this time whether one base material is better than another for galvanized sheets to be used underground, but it appears that any difference which may exist is not great. WAT(4)

The Corrosion of Early Chinese Bronzes. WILLIAM F. COLLINS. *Journal of the Institute of Metals*, Vol. 45, No. 1, 1931, pages 23–55 (with discussion) abstracted in *Engineer*, Vol. 131, Mar. 20, 1931, page 327; *Engineering*, Vol. 131, Mar. 13, 1931, page 366.

Paper read before the Institute of Metals, Mar. 11, 1931. See *Metals & Alloys*, Vol. 2, May 1931, page 97. LFM(4)

The Resistance of Wrought-Iron Vessels to Fluorosulphonic Acid. (Ueber die Widerstandsfähigkeit von schmiede-eisernen Gefässen gegen Fluorsulfonsäure.) HANS J. BRAUN. *Metallbörse*, Vol. 20, Sept. 24, 1930, page 2134.

From the results obtained on testing the resistance of a wrought-iron retort to $HFSO_3$ at ordinary temperature, at 130° and at 150° C. it is concluded that wrought-iron vessels are sufficiently resistant to this acid. The method of testing is described. WHB(4)

Corrosion of Iron and Steel in Ship Structures. J. W. DONALDSON. *Iron & Steel Industry & British Foundryman*, Vol. 4, June 1931, pages 313–316.

Causes of corrosion and methods for corrosion prevention of ship structures are discussed. The author summarizes data from other investigations on the relative corrodibilities of various commercial forms of iron and steel in sea water. CHL(4)

The Ways in Which Rust Forms. (Les Modes de Formation de la Rouille.) GEORGES CHAUDRON. *Chimie et Industrie*, Vol. 26, Apr. 1931, pages 273–279.

The conclusions which are made follow: all the ways for decreasing or stopping the rate at which flakes are formed can be utilized for protecting metals; progress has been made in electrochemistry, and research may be expected to follow this trend; important discoveries will be made in the laboratories where science has the best of knowledge and apparatus. Various methods for the protection of rust are discussed: the electrochemical theory of corrosion; the phenomena of Evans; corrosion tests made under pressure of oxygen; the function of a flake: aerated and non-aerated iron; corrosion by seawater; protection by plugs, by cathodic polarization, by polarization of anode surfaces; the corrosion of iron by rust; the application of protective paints and their choice. MAB(4)

Classification of Corrosion-Resisting Steels. H. N. BOOKER. *Paper Industry*, Vol. 12, Aug. 1930, pages 849–851.

The corrosion-resisting steels at present on the market are grouped into 4 classes, and a few of the properties of each group are given. WHB(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Structure of Copper-Zinc Alloys. (Sur la structure des alliages cuivre zinc.) W. Broniewski & J. Strasburger. *Revue de Métallurgie*, Vol. 28, Jan. 1931, pages 19–29; Feb. 1931, pages 79–84. 41 references.

Published data do not definitely establish the composition of the particular compounds of Cu–Zn system. To obtain the necessary equilibrium specimens cast in chills and containing less than 49% Zn were annealed at 400° for 1000 hours, and those with higher content of Zn for 3000 hours. The treatment was conducted in an electric furnace well luted with fire clay so that the changes in the composition were found only in a very thin outside layer of specimens. Parallel series of tests were made on cast and annealed specimens. Electrical conductivity, thermoelectric power, electromotive force of the solution, dilatation and Brinell hardness were determined. These tests and microscopic evidence placed the limits of solid solubility of α-phase between 0 and 35 atomic %, of β 46 to about 49%, of γ 59 and 67%. After 3000 hours annealing ϵ-phase was never perfectly homogeneous which interfered with the determinations of its limits of solid solubility which tentatively can be given as 79 and 87%. The range for η-phase is within 98 and 100% Zn. The existence of CuZn, $CuZn_2$ and $CuZn_8$ at room temperatures was reasonably well established. The shifting of the maxima of corresponding curves from theoretical 50% to about 49.6% can be explained on the assumption of the partial decomposition of CuZn into γ-and α-phases. JDG(5a)

MultiComponent Systems Involving Iron. III. The System Iron–Phosphorus–Silicon. (Ueber Mehrstoffsysteme mit Eisen. III. Das System Eisen–Phosphor–Silizium.) W. Hummitzsch & F. Sauerwald. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 194, Dec. 9, 1930, pages 113–138.

The system, containing an excess of Fe was examined chemically, thermally and metallographically. Fe_3P–FeSi is quasi-binary. Fe–Fe_2Si–FeSi is an independent, 3-component system. Fe_3P–FeSi is not quasi-binary. A ternary eutectic at 1018° consisted of 6.35% Si; 7.45% P; 86.20%Fe. At 1110° there is an equilibrium of the form: Liquidus k + Fe_3P = Fe_2P + FeSi. The liquidus is 13.55% Si; 6.00% P; 80.45% Fe. Eleven diagrams are given and discussed; also a number of photomicrographs. (5a)

The Mode of Deformation of a Single Crystal of Silver. H. J. Gough & H. L. Cox. *Journal Institute of Metals*, 45, No. 1, 1931, pages 71–97 (with discussion); abstracted in *Engineer*, Vol. 151, Mar. 20, 1931, page 328; *Engineering*, Vol. 131, Mar. 13, 1931, pages 366–367.

Original paper read before the Institute of Metals, Mar. 11, 1931. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. LFM(5a)

A Note on the Silver-Rich Aluminium-Silver Alloys above 600° C. T. P. Hoar & R. K. Rowntree. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 119–125; abstracted in *Engineering*, Vol. 131, Mar. 20, 1931, page 382.

Includes discussion. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. LFM(5a)

Constitution of Aluminum-Iron-Silicon Alloys. (Konstitution der Al-Fe-Si Legierungen.) V. Fuss. *Metallbörse*, Vol. 20, Dec. 13, 1930, page 2734.

Fuss' results are not in accord with those of Fink and Van Horn or those of Dix and Heath. He found only one intermetallic compound at the Al end of the diagram. This compound contained approximately 23% Si and 77% $FeAl_3$. This corresponds to $Al_3Fe_2Si_3$ and is probably identical to Dix and Heath's β Fe-Si. Fuss found a peritectic between the $FeAl_3$. Microscopic examination was employed. No other method of examination was mentioned in the abstract. WHB(5a)

The Macro-Etching of Aluminium-Silicon Alloys. William Hume-Rothery. *Institute of Metals, Advance Copy* No. 572, Sept. 1931, 4 pages.

The macrostructures can be brought out by etching in an aqueous solution containing 150 to 160 grams of $CuCl_2$ per liter. The specimen is held in the solution until a vigorous reaction occurs, removed, the deposited Cu brushed off, and this procedure repeated until the desired effect is produced. A final brightening may be produced by immersion in a solution of CrO_3. 1 reference. JLG(5a)

Transformations in the Copper-Gold Alloys. John L. Haughton & Ronald J. M. Payne. With an Appendix on X-ray Examination of Gold-Copper Alloys. G. D. Preston. *Institute of Metals, Advance Copy* No. 571, Sept. 1931, 24 pages.

Alloys from 20 to 70 atomic % Au were studied by determining the electric resistance of the slowly cooled alloys at room temperature, by determining the change in resistance with change in temperature and by microscopic examination. The existence of transformations in alloys corresponding to the formuae AuCu and $AuCu_3$ were confirmed, and a third transformation corresponding to a third compound, Au_2Cu_3, was detected. An equilibrium diagram is drawn to show the transformations by which the supposed compounds are formed. The crystal structures of some of the alloys were studied by X-ray methods. The quenched 51.2 atomic % Au alloy had a face-centered cubic lattice (3.94 A. U.), and gave no indication of a regular arrangement, as to kind, at the points of the lattice. This alloy when slowly cooled had a body-centered tetragonal lattice (a = 2.79 A. U., c/a = 1.31) with the Au and Cu atoms arranged regularly at points of the lattice. The transformation temperatures were dependent on the O content of the alloys, and it was found necessary to melt in a vacuum. An appendix describes the method and fixtures used in determining the electric resistance throughout a temperature range. Contains 7 references. JLG(5a)

The System Iron–Carbon–Vanadium. (Beitrag zur Kenntnis des Systems Eisen–Kohlenstoff–Vanadin.) Hans Hougardy. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1930, pages 497–503; *Stahl und Eisen*, Vol. 52, May 7, 1931, pages 592–593; *Mitteilungen aus dem Forschungs-Institut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund*, Vol. 2, No. 3, 1931, pages 39–60.

The effect of V upon the physical properties of Fe-C alloys was studied with steels containing C: 0.10%, 0.30%, 0.70%, 1%, 1.50%, 2%, 2.50% and 3%; V: 0.40%, 0.80%, 1.50%, 2.50%, 4%, 5.60%, 8%, 12% and 16% The ability of V to suppress the γ-phase of pure Fe is not abolished by C but only shifted to higher contents of V. F. Wever and W. Jellinghaus found that the γ-field is closed at 1.1% V. In the presence of C, the percentage of V at which the γ-field is closed is governed by the relation $V = \frac{C}{0.175} + 1.1$, where C is the carbon content. With lower V contents only V_4C_3 is formed and no Fe_3C is present. Only excessive amounts of V form solid solutions with Fe. V_4C_3 and Fe_3C form no double carbides; however, at higher temperatures limited amounts of V_4C_3 are dissolved in γ-Fe. The particulars of the results on hardness, hardenability, deep hardening, appearance of fracture, critical points, structure of the steels tested are due to the above behavior of V and V_4C_3, respectively. The hardenability (hardness vs. quenching temperature) is retarded above certain contents of V (relative to the content of C) and finally the hardness does not increase at all with the quenching temperature. The A_1 point is in the average increased by 10° independent of the amount of V. The lower boundary lines of the γ-field are shifted to higher carbon contents without essentially affecting the size of the γ-field. New structures were not observed in the steels investigated. The 3-dimensional diagram Fe-C-V was established up to 3.4% C and 5.6% V. GN+GTM(5a)

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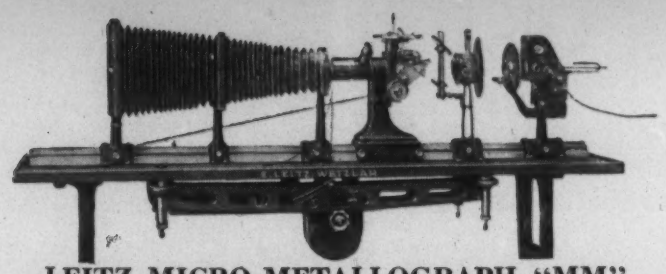

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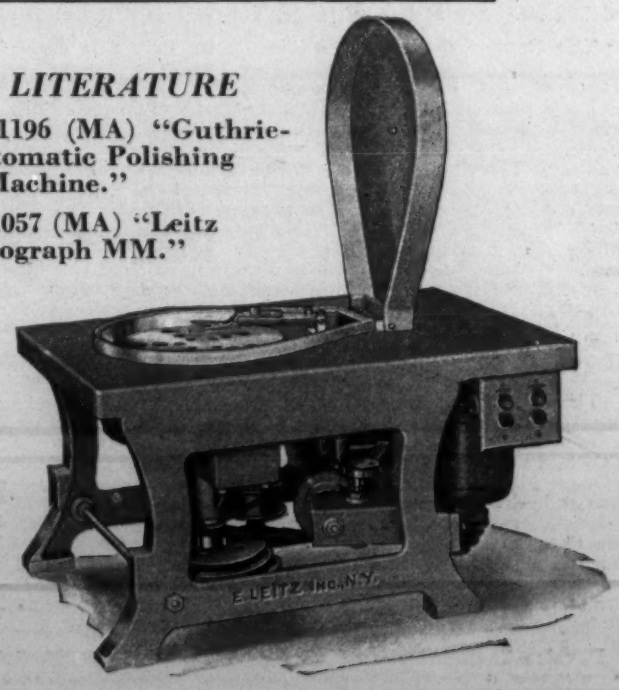

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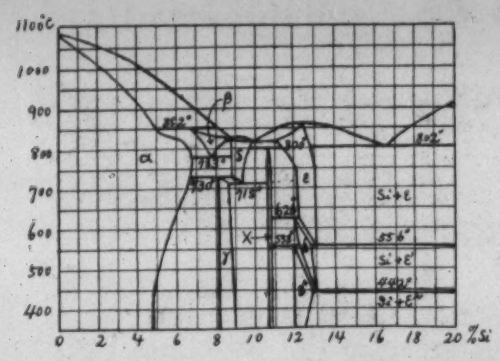
On the Equilibrium Diagram of the Copper-Silicon System. K. Iokibe. *Kinzoku no Kenkyu*, Japan, Aug. 1931, pages 433–456.

The equilibrium diagram of the Cu-Si system was investigated by means of total and differential thermal and dilatometric analyses, electric resistance measurement and microscopic examination. The diagram, obtained by the author, showed the following: (1) A homogeneous phase "X" having the composition of 89.4–89.3% of Cu and 10.6–10.7% of Si is formed at 800° C. by the peritectoid reaction $\delta + \epsilon \rightleftarrows X$. The reaction is very slow and was found only in annealed specimens. The electric resistance of "X" phase is very small compared with that of γ and ϵ'' phases. (2) The δ—γ transformation which had been thought to exist in the heterogeneous range lying between α and ϵ, is now proved to appear, in the equilibrium condition, only in the alloys containing less Si than that of "X". Similarly, the ϵ—ϵ' transformation appears only in the alloys whose Si content exceeds that of "X." (3) Besides the known transformation ϵ—ϵ' (626–556° C.), the ϵ phase shows another one ϵ''—ϵ', the transition interval lying between 558° and 442° C. KT(5a)



The Affinity of Metals for Sulphur. I. The Thermal Equilibrium between Hydrogen and the Sulphides of Iron, Tin, Cadmium, Bismuth and Antimony. (Die Affinität von Metallen zu Schwefel. I. Mitteilung. Das thermische Gleichgewicht zwischen Wasserstoff und den Sulfiden von Eisen, Zinn, Cadmium, Wismut und Antimon.) E. V. Britzke & A. F. Kapustinsky. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 194, No. 4, 1930, pages 323–350.

The thermal equilibria between H and the sulphides of Fe, Sn-Sb, Bi and Cd were investigated in the temperature range from 400° to 1000° C. The results are tabulated and the dissociation-tensions, heat of formation of sulphides and the affinities to the metals in question are determined Ha(5a)

On the Inverse Segregation in Simple Eutectic Alloys and Its Mechanism. K. Iokibe. *Kinzoku no Kenkyu*, Japan, July 1931, pages 372–397.

The inverse segregation was observed in Zn-Sn alloys which form a simple eutectic. The density of the inner portion of the castings is smaller than that of the outer portion. The chemical analysis showed that the former contains more Zn and hence is lighter than the latter. This fact was also confirmed by microscopic observation. The inverse segregation was found to be more conspicuous when the solidification interval was great. The dissolved gas had no effect upon the inverse segregation. Many minute cavities were found in the center of the ingot, this causing the low density. The contraction of casting was greatest at the center. From these facts the author concluded as follows: By the solidification shrinkage of primary crystals shrinkage cavities are formed at the outer portion of the ingot and cause the outward movement of the mother liquid from the inner portion. Thus, more Sn is contained at the outer portion and the minute cavities are formed at the central portion by the lack of eutectic liquid and hence the mean composition at the center becomes rich in Zn. KT(5a)

The World's Most Powerful Microscope. F. F. Lucas. *Journal of the Society of Motion Picture Engineers*, Vol. 16, April 1931, pages 445–456.

Koehler of the Zeiss Works developed, about 30 years ago, a microscope using ultra-violet light. It was forgotten until the Bell Telephone Laboratories developed another recently. With the microscope it is possible to obtain brilliant images of metallurgical specimens magnified 5000–6000 diameters. The ordinary type microscope is limited to 1000–1500. Gives a full account of construction and operation of the microscope. RHP(5a)

Chrome-Nickel Alloys. V. N. Krivobok. *Foundry Trade Journal* Vol. 43, Nov. 27, 1930, page 374.

Abstract of report read before the Metallurgical Advisory Board of the Carnegie Institute of Technology and the Pittsburgh Experiment Station of the U. S. Bureau of Mines. The paper was entitled: "Chrome-Nickel Alloys—Constitutional Diagram of 18% Chromium-Iron Alloy with Variable Composition of Nickel and Carbon. Disintegration of 18–8 Alloys." Alloys investigated ranged from 0.046 to 0.34% C, 17.20 to 18.38% Cr and 7.82 to 8.57% Ni. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. VSP(5a)

The Copper-Magnesium Alloys. Part IV. The Equilibrium Diagram. W. R. D. Jones (University College Cardiff). *Institute of Metals, Advance Copy* No. 574, Sept. 1931, 25 pages.

Previous work on the Cu-Mg system is reviewed. The equilibrium diagram was studied by thermal and microscopic methods. The alloys were melted in a vacuum and the freezing points determined as they cooled in the vacuum. During solidification, the furnace was shaken to prevent excessive segregation. At ordinary temperatures, about 0.02% Cu is soluble in Mg and 2.0–2.2% Mg in Cu. The compounds Mg_2Cu and $MgCu_2$ exist and do not form solid solutions. The Mg-rich solution forms a eutectic with Mg_2Cu at 30.7% Cu with a melting point of 485° C. The 2 compounds form a eutectic containing 65.4% Cu and melting at 552° C. The compound $MgCu_2$ and the Cu-rich solution form a eutectic at 90.3% Cu and 722° C. Contains 12 references. JLG(5a)

Dilatometric Study of Chromium-Nickel-Iron Alloys. Vsevolod N. Krivobok & Maxwell Gensamer. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 434, Sept. 1931, 23 pages.

The effects of cooling to subatmospheric temperatures on the room temperature properties of steels containing 18% Cr and varying amounts of Ni were studied. The steels contained various C contents. A mixture of solid CO_2 and acetone gives a sufficiently low temperature to produce hardening in some alloys. The hardness produced in some quenched austenitic alloys was as high as 50 Rockwell C. A dilatometric study of the steels from the low temperature to heat treating temperature proved that the hardening at low temperature was due to the decomposition of the austenite. The transformation at low temperature was very rapid. Both C and Ni tend to lower the temperature at which austenite is decomposed. The results of the dilatometric study of the steels are discussed in detail. Contains 5 references. JLG(5a)

Physico-Chemical Study of the Gold-Copper Solid Solutions. N. S. Kurnakow & N. W. Ageew. *Institute of Metals, Advance Copy* No. 576, Sept. 1931, 17 pages.

Previous work on this alloy system is reviewed. Resistance measurements and a dilatometric study proved the existence of the compounds AuCu and $AuCu_3$, which form from the solid solution at a temperature of 425–450° C. They both form solid solutions, the $AuCu_3$ existing from 22 to 40 atomic % Au, and AuCu from 42.5 to 70 atomic % Au. The formation of both compounds can be retarded by rapid cooling. The formation of the compounds is accompanied by a marked decrease in volume. 34 references. JLG(5a)

The System Iron-Nitrogen. (Beitrag zur Kenntnis des Systems Eisen-Stickstoff.) W. Köster. *Archiv für Eisenhüttenwesen*, Vol. 4, May 1931, pages 537–539; *Stahl und Eisen*, Vol. 51, June 11, 1931, page 740.

The author critically reviews the recent investigations of the Fe-N system by O. Eisenhut and E. Kaupp (*Zeitschrift für Elektrochemie*, Vol. 36, 1930, pages 392–404) and by E. Lehrer (*Zeitschrift für Elektrochemie*, Vol. 36, 1930, pages 460–473) and gives the results of his own investigations. The results of the above mentioned authors are in agreement but for the concentrations of 4–6% N with the transformations between the phases γ, γ' and ϵ. Eisenhut and Kaupp give a peritectoid transformation, Lehrer, a eutectoid one. In microscopically examining the outer layers of nitrided electrolytic Fe (8 hrs. at 650° in ammonia), the author found them, too. This result is also borne out by the results of some heat treating tests. The eutectoid with the low N content, Braunite, is transformed to martensite and austenite in quenching from 600° C. The eutectoid with the higher N content is still unchanged by quenching from 700° C. In 12 micrographs, it is shown that the relative behavior of the homogeneous Fe-Ni phases α, γ, γ' and ϵ, its transformations and changes of solubility at slowly cooling, as well as the formation and decomposition at quenching and tempering can be microscopically studied. These observations are in agreement with those of Eisenhut, Kaupp and Lehrer. Up to 3% N, Fe-N alloys show a behavior similar to Fe-C alloys. GN(5a)

A Study of the Constitution of the Iron-Tin Alloys. C. A. Edwards & Preece (University College, Swansea). *Iron & Steel Institute, Advance Copy* No. 8, Sept. 1931, 14 pages.

Early work on the Fe-Sn system is reviewed. The existence of 3 compounds was proved. Fe_2Sn is stable between 760° and 900° C., but can react with Sn at 800° C. to produce the compound FeSn. FeSn is stable at all temperatures below 800° C., but reacts with Sn at 496° C. to form $FeSn_2$. $FeSn_2$ exists below 496° C: on heating, it decomposes into FeSn plus a Sn-rich liquid. No polymorphic changes occur in $FeSn_2$ as suggested by Wever and Reinecken. Approximately 18% Sn is soluble in Fe at 760° C. Below this temperature, the solubility decreases to about 10% at 300° C. 2 references. JLG(5a)

The Iron-Carbon System. (Le système Fer-Carbone.) L. Dupuy. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 283–289.

Includes discussion and 11 figures. Review of the history of the Fe-C diagram with a "1930" diagram. This was criticized in discussion for not representing the fact that the solubility of C in α-iron changes with temperature so as to allow precipitation hardening. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. HWG(5a)

Structure and Properties of Pearlite. (La perlite, sa structure et ses propriétés mécaniques.) N. T. Belaiew. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée*, Section de Métallurgie, 6 session Liege, June 1930, pages 257–261.

Discusses relation of mechanical properties to the interlamellar distance between the cementite layers of pearlite. See *Metals & Alloys*, Vol. 2, July 1931, page 127. HWG(5a)

The Diffusion of Tin into Iron with Special Reference to the Formation of Columnar Crystals. C. O. Bannister & W. D. Jones. *Iron & Steel Institute, Advance Copy* No. 3, Sept. 1931, 23 pages.

The diffusion of Sn into Fe was studied by heating iron cylinders containing a plug of Sn to various temperatures, sectioning, and examining the resulting microstructures. The behavior depends on the temperature. Below 900° C. little change in the Fe could be observed. Above 900° C., and below A_4, a band of columnar crystals is formed. Columnar crystals have been observed when other metals that form a closed γ-loop diffuse into Fe, and when steel is decarburized at certain temperatures. The formation of the columnar crystals results from the transformations of γ to α Fe at a constant temperature as the Sn content of the Fe increases. Columnar crystals are therefore not formed below the A_3 temperature. An experiment indicated that they were likewise not formed by diffusion above the A_4 temperature. The rates of diffusion for several temperatures were studied and formulae derived for expressing the rate of diffusion as a function of the temperature. 24 references. JLG(5a)

On the Structure of Nodular Troostite. N. T. Belaiew. *Iron & Steel Institute, Advance Copy* No. 4, 1931, 19 pages.

From a study of high-magnification micrographs, it was found that the interlamellar distance in troostite is about 100 $\mu\mu$. Troostite under high magnification has the appearance of pearlite under a lower magnification. Troostitic nodules differ in appearance from pearlite in having a fan shaped structure. The various structures found in eutectoid steel and their hardness values are discussed. It is concluded that even though each contains structures common to all of the structures observed in eutectoid steel pearlite, sorbite and troostite should be considered as distinct and different constituents of steel. Contains 30 references. JLG(5a)

Some Important Factors Controlling the Crystal Macrostructure of Copper Wire Bars. L. H. DeWald. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 429, Sept. 1931, 12 pages.

The influence of the following conditions on the macrostructure of Cu wire bars were studied: (1) temperature of metal as cast, (2) casting speed, (3) temperature of mold, (4) time the bar remains in mold after solidification before quenching, and (5) circulating volume of quenching water and its temperature. Conditions 1 to 3 influenced the structure, but 4 and 5 did not. A fine equiaxed structure can be produced with low casting temperature, low mold temperature and slow pouring. Heating at the rolling temperature did not alter the macrostructure. In processing bars of coarse and fine grained Cu to form 24 gage wire, no differences could be found in the mill performance between bars of different grain size. It is stated, however, that tough-pitch Cu cast at low temperatures, and hence being fine grained, is preferable for the production of fine wire. 11 references. JLG(5a)

Copper-Nickel-Silicon Alloys, Rich in Copper. (Sulle leghe rame-nickel-silico, ricche in rame.) E. Crepaz. *La Metallurgia Italiana*, Vol. 23, Aug. 1931, pages 711–716. 7 figures, 6 references.

Previous work of Smith on solid solubility of Si in Cu was confirmed, and the study extended to ternary alloys of Cu containing up to about 7% Si and 9% Ni. Thermal analysis, hardness and microscopic structure were determined. Results plotted on a ternary diagram show that at 880° C., alloys with 1% Ni, 3% Si to 6% Ni, 1% Si are homogeneous solid solutions while the solid solubility at 500° C., probably falls to around 2% Si with 1% Ni and ½% Si with 2% Ni. The iso-hardness curves on the ternary diagram show an inflexion at compositions corresponding to the ratio 2 Ni : 1 Si indicating that when sufficient Ni is present to give that ratio, the Si is present as Ni_2Si. HWG(5a)

Eutectic Castings. (Fonte eutectique.) Bettinger. *Revue Fonderie Moderne*, Vol. 25, 1931, pages 267–270.

Formulae are developed which allow the chemical composition of a eutectic casting (an alloy which is defined by the temperature at which the entire solution solidifies instantaneously and completely) to be calculated. Tables are made up from which, for any desired thickness of material, these compositions can be taken. The tensile strength can also be calculated from the chemical composition for which the formula and an example are given. Ha(5a)

Occurrences during the Formation of the Martensitic Structure. (Ueber die Vorgänge bei der Ausbildung des Martensiticgefüges.) H. HANEMANN, K. HERRMANN, N. HOFMAN & A. SCHRADER. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 479–484; *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 646–647.

The authors summarize their results as follows: (1) The structural component η which may be detected microscopically corresponds to the tetragonal phase of hardened steel. (2) Pseudomorphoses are formed in quenched steel, (a) in the tempering, the structure of the δ-phase changes without showing up a change of shape in the micrograph, (b) the η-phase shows an individual crystal type but X-ray investigations did not reveal a structure which differed from α-iron. This indicated the presence of a pseudomorphose. (3) Cementite is formed only at the second transformation of martensite. (4) The state between the first and second transformation of martensite, called ξ, contains a distorted α-iron lattice with interspersed and adsorbed C atoms. GN(5a)

Carbon Content of the η-Phase. (Ueber den Kohlenstoffgehalt in der η-Phase.) H. HANEMANN. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 485–486; *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 647–648.

If quenched steel is tempered above temperatures of the second transformation of martensite (about 300° C.), it is composed of a matrix of α-iron with embedded, very fine globules of cementite. In tempering for a longer time, it depends upon the particle size of the cementite in the austenite and the η-needles whether C diffuses from the η-needles into the austenite or vice versa. The following experiment was made to determine the C content of the η-phase. A quenched 1.67% C steel and composed of austenite and η-needles was heated at 930° for 10 mins. and then quenched in water. The structure now shows a C distribution corresponding to the original quenched structure. Areas corresponding to the original η-needles only contain martensite, whereas the areas corresponding to the original austenite show martensite and cementite. Such a structure would not be possible if the η- needles, after the first quenching, had not contained a C content of about 1.1%. There obviously exists a difference between the C content of the austenite and the η-martensite needles. GN(5a)

Etching with Alkaline Sodium Picrate Solution and Its Use to Detect the Occurrences in Tempering Quenched Steel. (Die Aetzung mit alkalische Natriumpikratlösung und ihre Anwendung zur Erforschung der Anlassvorgänge im gehärteten Stahl.) H. HANEMANN & A. SCHRADER. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 475–477; *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 645–646.

Etching temperatures between 40–60° C. are suitably used in etching with alkaline solutions of sodium picrate to detect the various tempering structures. The velocity of etching differs for the various structural components. FeC_3 is always etched by picrate. Ferrite, austenite and the η-phase are not colored by picrate. Since the tempering effect of the η-phase has a noticeable velocity even at 70° C., and the η-phase is then darkened, it is advisable to etch at first at room temperature in observing structures containing the η-phase. The ξ-component etches much more slowly than the Fe_3C. In etching for 40 mins. at room temperature, Fe_3C is darkened whereas the ξ-component remains bright. The δ-phase is still less attacked than the ξ-phase. The best etching temperature to distinguish ξ and δ is between 50–60° C. Austenite is attacked when the steel is heated above about 250° C. the ξ-phase is homogeneously etched till the occurrence of the second transformation of martensite. After the occurrence of this transformation, a heterogeneous picture will be seen. GN(5a)

Atlas Metallographicus. H. HANEMANN & A. SCHRADER. Gebrüder Bornträger, Berlin, 1930. Paper, 8 × 11 inches, Section 8, plates 57–64. Price 13.20 RM. Section 9, plates 65–72. Price 15.60 RM.

The latest published sections of this marvelous standard work are devoted to the study of some occurrences which are of extreme importance for the ferrous metallurgist. They are an excellent study of the effect of heat upon the structure of steel. In section 8, plates 57–59 show the structures of steel as affected by carbon content and cooling velocity; illustrations are included which show the variation of grain size with the variation of the conditions mentioned above. Plates 60 and 61 are devoted particularly to the influence of the cooling velocity upon the crystallization of ferrite as well as pearlite. Plates 62–64 deal with banded structure and the means of eliminating this phenomenon.

Section 9 (plates 65–72) continues the occurrences shown by the photographs of Section 8 in more detail and gives some illustrations of problems which can be of great concern to the steelmaker. Reference may be made to only the 8 pictures of plate 69 which the author brings under the heading "The origin of abnormal pearlite." This abnormal pearlite appears in low C steels, possibly below 0.10% C, at low cooling velocities and shows large crystals of cementite surrounding the few areas of lamellar pearlite. This cementite, though in appearance like the tertiary cementite which is caused by the slight solubility of C in α-Fe, is different from this one and generally does not appear in low carbon steels of a larger grain size. Whereas the intersticial cementite caused by the abnormal crystallization of pearlite can be eliminated by rapidly cooling the steel from a higher finishing temperature. A study of these pictures may be recommended to anyone who has much trouble in obtaining a proper structure in low carbon steel rods.

The next sections of the Atlas Metallographicus are announced as being devoted to the changes of structure due to cold work and recrystallization and the structures of non-hardened carbon steel shall then be concluded.

Looking over again all the sections which have been published so far, one feels as though a picture gallery had been visited and it is no exaggeration to say that each picture is a classic one. Time and study are important for a thorough appreciation of them.—G. Neuendorff (5a)-B-

Another Etching Reagent for Aluminum Alloys. (Nog een etsmiddel voor aluminumlegeeringen.) J. G. S. DE HAAN. *De Gieterij*, Vol. 5, Apr. 1931, pages 50–51.

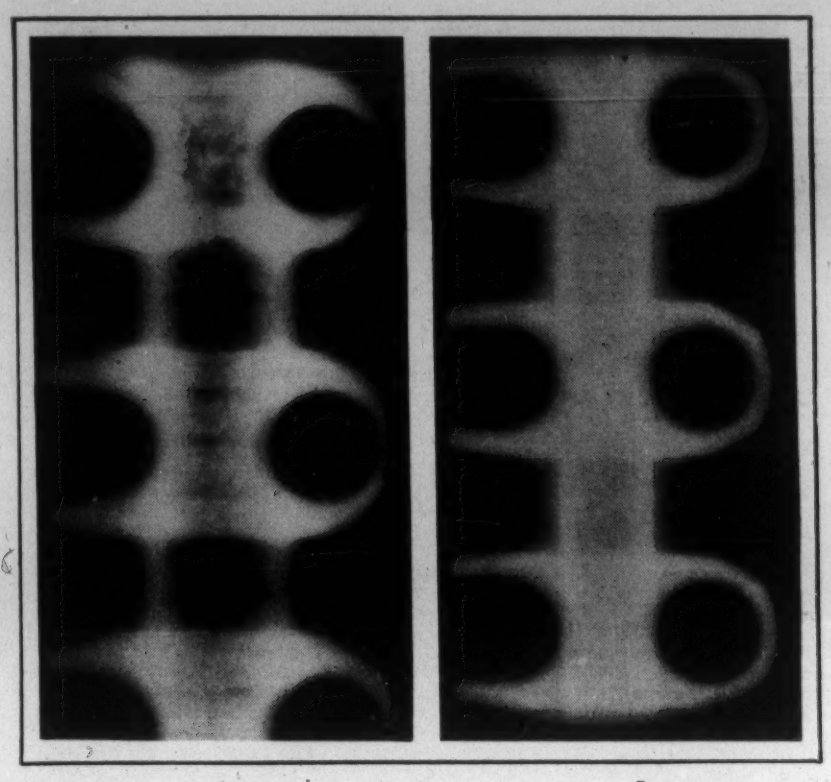
For silumin the author obtained good results by polishing first with a 10% "solution" of alumina No. 1, followed by a polish-attack with a 5% solution of alumina No. 2 containing about 0.05% $FeCl_3$. HSvK(5a)

The Investigations of G. Tammann on the Constitution of Alloys. (Die Forschungen G. Tammanns über die Konstitution der Legierungen.) G. GRUBE. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 137–138.

Discusses the research work of Tammann and his co-workers done on the constitution of alloys and emphasizes the development of the thermal analysis and constitutional diagrams. EF(5a)

The Constitution of Zinc Lithium Alloys. (Die Konstitution von Zinc-Lithium-Legierungen.) W. FRAENKEL & R. HAHN. *Metallwirtschaft*, Vol. 10, Aug. 14, 1931, pages 641–642.

Zn alloys containing up to 9% Li were melted in porcelain crucibles lined with magnesia under a protective flux of LiCl and Li_2CO_3. Zn was melted first and Li introduced under the surface to prevent loss by oxidation. Cooling curves were determined and the alloys were examined microscopically. The melting point of Zn drops to 402° at the eutectic with 0.6% Li, then rises at first rapidly then more moderately up to about 6% Li. Evidence points to the formation of the compound Zn_2Li_2. The higher Li alloys are brittle and tarnish rapidly. In the photomicrographs, the 0.5% Li shows primary Zn crystals and a small amount of eutectic. The 0.75% Li alloy is almost all eutectic and the 1% Li alloy shows primary crystals of the compound. CEM(5a)



A B

Radiographic comparison of malleable iron castings made in different foundries. (a) Shows shrinkages over practically full length (b) shows no imperfections, indicating correct foundry practice.

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Structure & X-Ray Analysis (5b)

Comments on Crystal Plasticity. (Bemerkungen zur Kristallplastizität.) W. Boas & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalt*, Sonderheft 10, 1930, pages 105–108.

An analytical discussion of shearing strength and shearing coefficients for different kinds of lattice structures. 22 references. Ha(5b)

The Value of X-Ray Inspection to Electric Arc-Welding. H. R. Isenburger. *Welder*, Vol. 2, Aug. 1931, pages 7–14.

The principal undesirable conditions in electric arc-welds revealed by radiographic examination are the following: (1) the improper fusion at scars between weld and parent metal, that is, no penetration; (2) laps not fused between layers of weld metal; (3) gas inclusions more or less numerous throughout the weld zone; (4) shrinkage cracks developed during or after welding. No penetration and laps are usually characterized by slag inclusions which may actually be slag but are usually a fine skin of oxide. Shrinkage cracks occur very seldom. Several examples of defects revealed in photographs are included. It is recommended that each welder learn to check his work with X-ray pictures. The cost of operating an X-ray installation is approximately $3.00–$5.00/hr., exclusive of investment. Ha(5b)

The Quantum Theory of Dispersion in Metallic Conductors. R. de L. Kronig. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 255–265.

In a previous paper (Kronig, *Proceedings of the Royal Society*, Vol. 124, page 409, 1929) the theory of dispersion in metallic conductors was formulated more precisely for the case of the temperature agitation of the metallic lattice. The absorption bands which dominate the optical behavior of metals in the visible and ultra-violet part of the spectrum are discussed in detail. An extension of the theory for the infra-red region of the spectrum, where the average time between 2 collisions of an electron with the metallic lattice is comparable with the period of the radiation is given. Explicit formulae for the index of refraction and the coefficients of extinction and reflection are derived which go over into the classical expressions of Drude in the limit $\gamma = 0$. The experimental data are compared with the theoretical results and found to give satisfactory agreement. The possibility of obtaining valuable information about the surface layers of metals from the optical constants is pointed out, as well as the desirability of measuring the temperature dependence of these constants in the infra-red. WAT(5b)

X-Ray Investigation on Copper-Arsenic Alloys. Nobuyuki Katoh. *Bulletin Chemical Society of Japan*, Vol. 5, Sept. 1930, pages 275–282.

Data are given for powder X-ray photograms of CuAs alloys with 19.6% As, 30.86% As cooled slowly and 30.86% As quenched from 630°. The dimensions of the elementary cube for the upper and lower limits of homogeneity for β Cu with approximately 29.1% As are calculated. WHB(5b)

Advances in Method and Application of X-Ray Investigation. (Fortschritte der Röntgenforschung in Methode und Anwendung. Ergebnisse der Technischen Röntgenkunde. II.) F. Körber & E. Schiebold, *et al.* Akademische Verlagsgesellschaft m.b.H., Leipzig, 1931. Cloth, 6 × 9 inches, 326 pages. Price 38 RM.

In *Metals & Alloys*, Volume I, page 918 appeared a review of a volume, which was designated as the first of what should prove to be a very interesting and valuable series presenting a cross section view of X-ray science as applied to the testing of materials at the present time. The second or 1931 volume of this series has now appeared and the promise displayed by the previous member of the series is more than substantiated. Twenty chapters are presented, again by outstanding authorities, as follows:

Researches with X-rays on Molecular Arrangement in Liquids by Debye and Menke.
X-ray Diffraction Photographs of Liquid Crystals in Magnetic and Electric Fields by Herrmann.
Roentgengraphic Researches on Fats, Oils and Greases by Trillat.
The Interferometric Research on Molecular Structure of Organic Compounds by Mark.
Interference Phenomenon of Electrons in Crystals by Rupp.
Modern Methods of Crystal Structure Analysis by Schiebold.
The Use of General Radiation in Fine Structure Research by Regler.
Roentgengraphic Determination of Size and Form of Submicroscopic Crystals by Brill.

The Dependence on Temperature of the Photographic Process by Eggert.
Intensity Measurements on Deformed Crystals and Mixed Crystals by Hengstenberg.
Crystal Chemistry and the X-ray Method by Goldschmidt.
New Results of X-ray Investigation in the Inorganic Field by Gottfried.
Results of Modern Investigations on Metals by Bernal.
The Classification of Iron Alloys by Wever.
Changes of State under Pressure of Alloys by Sachs
Quantitative X-ray Spectrographic Analysis with Secondary Rays by Hevesy.
X-rays and Chemical Combination by Stintzing.
New Physical and Economic Principles of Technical Radiography by Berthold.
Densographic Interpretation of X-ray Shadow Pictures of Pieces of Metal by Schwarz.
Diascopic Researches with X-rays by Lefring.

Anyone who is interested in X-ray developments, particularly from the chemical and industrial point of view is more and more impressed by the great service which is being given in these condensed and inspiring accounts of the most recent results in the numerous fields of investigation. The attempt to keep in touch with the almost overwhelming number of original papers now being published is discouraging, and the only hope, therefore, is to be found in critical condensed accounts of each subject by men best qualified in each field. The reviewer is frank to confess that he found this new volume as hard to put down as an excellent novel. It is unquestionably the best method of becoming acquainted with the very newest developments. The value and excellence of this series devoted to reporting the progress of technical X-ray science are assured and Volume III can come none too soon. It is to be hoped that the collection can be made even more international in character, although it is to be observed that a Swiss, a Frenchman and an Englishman have contributed important chapters in the present volume. It is a distinct pleasure to recommend it as a necessary addition to the equipment and knowledge of anyone who is even remotely interested in x-rays as a great research tool.—G. L. Clark (5b)-B-

An X-Ray Radiation Suitable for Determining Small Deviation in the Lattice Constants of Alpha-Iron. (Eine zur Bestimmung von kleinen Aenderungen in der Gitterkonstanten von alpha-Eisen geeigneten Röntgenstrahlung.) A. E. van Erkel & W. G. Burgers. *Zeitschrift für Metallkunde* Vol. 23, May 1931, pages 149–151.

Paper suggests the utilization of Co K_α radiation ($\lambda K_{\alpha 1}$ = 1.78578 A.U. and $\lambda K_{\alpha 2}$ = 1.79006 A.U.) for determining the space lattice of α-Fe. Exceedingly distinct interference lines are secured due to a selective absorption of the $K\beta$ radiation. The experimental facilites are described and the method of determining small deviations of the space lattice constants due to impurities or elastic stresses is fully outlined. EF(5b)

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The CHEMICAL CATALOG CO., *Inc.*
419 FOURTH AVENUE NEW YORK, U. S. A.

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Magnetic Inspection Achievements to Date. LEWIS S. REID. *Metal Progress*, Vol. 19, June 1931, pages 40–44.

The author briefly describes what happens when magnetic influences are impressed upon steel. The merits of direct and alternating current for magnetic testing are discussed. One circuit for use of alternating current in magnetic analysis is described and its applications in non-destructive testing described. WLC(6)

Magnetic Analyses. Report of A.S.T.M. Committee A-8. R. L. SANFORD, Chairman. *Preprint* No. 15 for June 1931 meeting, *American Society for Testing Materials*, 1 page.

Brief progress report. No technical data. HWG(6)

Power-Bending Diagrams of Notch Impact Tests. (Kraft-Durchbiegungs-Schaubilder von Kerbschlagversuchen.) R. MAILÄNDER. *Stahl und Eisen*, Vol. 51, Apr. 2, 1931, page 437.

Abstract of paper by T. Asano in Memoirs Ryojun College of Engineering (Port Arthur, South Manchuria). The author describes a new method to determine the forces brought about in notch-impact specimens during the test. For this purpose the specimens are clamped in an Izod machine so that the notch is somewhat outside of the clamp. A mirror is attached to the specimen between notch and clamp. A light ray thrown upon this mirror records the deformation of the specimen on a photographic plate as indicative of the force of impact. R. Mailänder discusses in his abstract some objections to the above simple method. GN(6)

Internal Stresses in Steel. Correspondence from E. W. EHN, Cannstatt, Germany. *Metal Progress*, Vol. 20, Aug. 1931, pages 88–89.

The writer reports work on a new method of determining internal stress in quenched steel. WLC(6)

Strain Measurements in the Reinforcement for the Natural History Building. W. C. LYON, H. L. WHITTEMORE, A. H. STANG & L. R. SWEETMAN. *Bureau of Standards Journal of Research*, Vol. 6, Feb. 1931, pages 183–194.

An interesting example of the use of the Whittemore strain gage in the measurement of stresses in indeterminate structures is presented in the reinforcement of the dome over the rotunda of the Natural History Building of the National Museum. A slight outward movement of the brick piers supporting the dome caused cracks to develop along the joints in the masonry and in the stone arches under them. To reinforce the structure the pendentives were surrounded by a steel framework. Inwardly directed forces were exerted on the masonry by many screw jacks, to prevent further movement. To control the jacking operation, readings were taken on a large number of gage lines on the frame work, using a Whittemore strain gage. The stress in the frame work was computed from these readings. Approximately the desired stress in each member was obtained. The safety of the dome and its supporting structure was thereby assured. The use and construction of the strain gage is described in detail. WAT(6)

Metallurgical Creep. A. G. HINTON. *Engineer*, Vol. 151, May 8, 1931, page 506.

A letter to the editor which sets forth an empirical formula which more accurately expresses the relation between stress and log creep strain per unit time than those heretofore. The equation is:

$$C = K\frac{(p-a)^3}{(b-p)^2}$$

where C = creep (strain per unit time)
p = tensile stress
K, a and b are constants which depend upon the temperature
a = stress for zero secondary creep
b = stress for infinite secondary creep

K is taken as the reciprocal of a quantity akin to viscosity. The formula, if true, implies that there is a definite limiting creep stress, a, and the fact that the formula agrees closely with experiments affords strong evidence that such a limiting creep stress actually exists. Secondary creep becomes infinite when p = b and zero when p = a. WAT(6)

A New Method for Testing Deep Drawing Sheets. (Sur une novelle methode d'essai des toles a l'emboutissage.) JEAN COURNOT. *Revue de Métallurgie*, Vol. 28, pages 254–258.

A description of the method proposed by Siebel and Pomp (*Stahl und Eisen*, Vol. 52, Dec. 26, 1929, pages 1866–1868) pointing out its advantages in comparison with the usual cup test. See *Metals & Alloys*, Vol. 1, May 1930, page 524. JDG(6)

Critical Review of Testing Methods for Welded Seams. (Kritische Betrachtung der Prüfverfahren für Schweissnähte.) H. KEMPER. *Autogene Metallbearbeitung*, Vol. 23, July 1, 1930, pages 199–205; July 15, 1930, pages 218–226; Aug. 1, 1930, pages 234–241; Aug. 15, 1930, pages 253–258.

A very exhaustive discussion deals with the different methods of testing the quality of a weld. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 144. Ha(6)

The Testing of Materials by Means of Magnetic Methods. (Werkstoffprüfung mittels magnetischer Arbeitsverfahren.) E. GEROLD. *Stahl und Eisen*, Vol. 51, Apr. 2, 1931, pages 428–432.

Abstract of a paper in *Mitteilungen Forschungsinstitut der Vereinigte Stahlwerke*, Dortmund, Vol. 2, 1931, No. 2, pages 23–37. 65 references. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 172. GN(6)

Dynamic Investigation of Railroad Bumpers. (Dynamische Untersuchung von Eisenbahnpuffern.) P. LANGER & W. THOME. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 8, 1931, pages 1013–1018.

The basis for the comparison of bumpers with helical springs, friction springs and liquid buffers is developed and the manner in which the behavior of the buffers can be determined is shown. The tests were made with railroad cars running against the buffer with a definite speed from which the energy acting on the buffer could be calculated and the compression of the buffer measured. Numerous curves illustrate the tests. 6 references are given. Ha(6)

Tests on Automobile Bearing Springs in the National Physical Laboratory. (Versuche mit Automobil-Tragfedern im National Physical Laboratory.) E. LEHR. *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 2, Aug. 1931, page 287–290.

Determination of the bending strength of laminated springs; endurance testing of the whole automobile bearing spring; testing the deflection of the spring while driving the car on all kinds of roads and at various speeds. MAB(6)

The Calculation of Helical Springs of Round Wire. E. HONEGGER. *Brown Boveri Review*, Vol. 18, Mar. 1931, pages 120–125.

The values for the greatest shear and normal stresses in transverse section of loaded helical springs are calculated. Both stresses occur at the innermost fibre of the spring coil. Both stresses act in the transverse section of the spring wire; an equal shear stress also acts in the longitudinal section. Discrepancies are important. The results of calculation in the 2 examples quoted agree very well with direct measurements. The method of calculation is simple enough for technical calculation, and is particularly applicable in the case of highly stressed close-coiled springs. MAB(6)

Crystallographic Investigation of Some Mechanical Properties of the Metals. I. The Plastic Bending of Crystal Plates. II. The Yield Point of Aluminum Crystals with Respect to Bending. III. On the Damping of Lateral Vibration of Aluminum Crystal Plates. IV. On the Internal Slip of the Metal. V. Fatigue of Metals under Alternating Torsion. Y. KIDANI. (In English.) *Journal of the Faculty of Engineering, Tokyo Imperial University*, Vol. 19, No. 1, June 1930, pages 1–15; No. 5, Feb. 1931, pages 107–129; No. 7, May 1931, pages 177–190.

Parts I, II. Asterism in Laue photographs of bent aluminum single crystals is due to slip. The yield point depends on the crystal orientation. The modulus of elasticity of the single crystals (8.5 × 10'' dynes) agrees with that of ordinary aluminum. The treatment is mathematical. Parts III, IV. The logarithmic decrement of single crystals of Al is not altered by crystal orientation at small amplitudes, but varies with orientation if the amplitude is so high that slip occurs. The modulus of elasticity calculated from the logarithmic decrement curves was found to be the same whatever the orientation. (The figure, 7.04 × 10'' dynes does not agree well with that found in Kidani's previous work.) In hard rolled Al, annealed at various temperatures, the logarithmic decrement falls rapidly when the metal has been annealed sufficiently to soften it. In 0.35% C steel, quenched and tempered at various temperatures, the decrement falls as the structure changes from martensite to troostite and then rises rapidly as sorbite appears. It falls again when the steel is annealed to a pearlitic structure. More energy is dissipated by sorbite than by the other structures. Annealed Al, Cu, Ni and 0.35% C steel were work-hardened to different degrees by tensile stretching and the logarithmic decrement determined. The decrement changes after the yield point has been exceeded, but the curves depend on the direction in which the specimen is cut in respect to the direction of working and on the amplitude used in the decrement test. The types of curves shown for the different metals vary widely. Part V. The title is rather a misnomer as no endurance limits were obtained. Three or four repeated torsion tests were made on each of 4 materials, annealed steels of 0.1, 0.3 and 0.6% C, and annealed copper, at such high stresses that fracture occurred in 200,000–270,000 cycles or less for the steels and 740,000 or less for the copper, save for one test on 0.1% C steel on which the plot indicates that it ran to about 400,000 cycles, but it is not stated whether the test was carried to fracture. The angular amplitude for a given torsional moment after varying numbers of cycles of repeated torsion is plotted. At the higher stresses it decreases sharply, then the change becomes less until, just before fracture, it rises sharply. As the stress is lowered the initial dip becomes smaller and the amplitude then remains nearly constant till just before fracture. Apparent constancy may be reached well above the endurance limit. Torsional damping tests were applied, at one stress only in each case, to 0.3% C steel and to copper. Plotting logarithmic decrement against number of cycles of repeated torsion before the damping test, the decrement rises for a while and then falls. The rise is assumed to correspond to the work-hardening stage (the tests were made at high stresses) and the fall to the "fatigue stage." One of the author's conclusions is that the rate of damping gave significant information as to the degree of fatigue. Since the tests were so few in number and the stress used so far above the endurance limit (fracture in 80,000 cycles for steel, 150,000 for copper) the conclusion is far too sweeping for acceptance without much further evidence. HWG(6)

Permeability Measurements on Iron in Case of D. C. Premagnetization. (Messungen der Permeabilität des Eisens bei Gleichstrom-Vormagnetisierung.) E. HÖLLER. Dissertation, Technische Hochschule Stuttgart, 1928, 23 pages.

The present investigation largely pertains to the formula of Spooner (*Journal American Institute Electrical Engineers*, 1923, page 42) giving the dependence of the additional permeability μ_Δ on the normal permeability $\mu_{Bm} = \frac{B_m}{H_m}$ and on the changes of the electrical field ΔB by alternating current: $\mu_\Delta = \mu_{Bm}(a + b \cdot \Delta B \cdot 10^{-3})$. New values for the constants a and b in the formula of Spooner were experimentally determined which yield more accurate results with pure iron and Si-sheets, whereas Spooner's constants are applicable best for magnetic and ordinary steel sheets. It was established that below 2000 Gauss $\mu_\Delta = \mu_{Bm}$. The constants a and b were also determined for the range of 150–2,000 Gauss. It was furthermore proved that the formula of Spooner is also applicable for superimposed A. C. of 50 Hertz frequency. The latter measurements were in fair agreement with corresponding experiments carried out with direct current. EF(6)

The Deformation of Metals under Prolonged Loading: Part I. The Flow and Fracture of Aluminium. HANSON & M. A. WHEELER. *Engineer*, Vol. 151, Mar. 27, 1931, pages 340–341; discussion *Engineering*, Vol. 131, Mar. 20, 1931, pages 383–384.

Abstract of paper read before the Institute of Metals, Mar. 12, 1931. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 144. LFM(6)

The Elastic Limit of Steel Plates. R. H. GREAVES. *Proceedings Cleveland Institute of Engineers*, 1930–31, Feb. 1931, pages 110–135.

The elastic limit of steel plates is discussed in relation to the usual methods of testing laid down in specifications. Determination of the true elastic limit involves very accurate and delicate measurements and its value is influenced to a high degree by slight differences in the previous treatment of the material of the test piece. The following conditions, among others, depress the observed elastic limit: (1) non-axial loading, (2) a bent test piece, (3) testing immediately after any form of deformation, that is, testing immediately after straightening by bending or by pulling, (4) straightening by bending in one direction only, even after subsequent resting. The following raise the elastic limit: (1) straightening by pulling and subsequent resting, (2) straightening by reversed bending and subsequent resting, (3) in some instances, removal of the surface of the plate. To obtain consistent results in a specification test designed to judge a material, as nearly as possible, by its elastic limit, it is important that the test should be applied under strictly standard conditions. WAT(6)

Methods for Determining the Roughness of Metal Surfaces. (Untersuchung verschiedener Methoden zur Bestimmung der Unebenheiten (Rauhigkeiten) von Metallflächen.) W. KIESEWETTER. Doktor-Ingenieur dissertation, Technische Hochschule, Dresden, 1931, 71 pages, 29 figures. Bibliography of 25 references.

Profile maps of the irregularities of a metal surface finished by machining, polishing, lapping, etc., may be drawn in various ways. Among these are: gelatine or similar casts can be sectioned and photomicrographs made; reflection methods can be used; or a phonograph needle bearing a mirror can be made to traverse the surface and the irregularities be magnified by an optical lever system, and photographically recorded. Or the irregularities may be recorded by a diamond point which scratches a glass slide, this being enlarged by making a photomicrograph and projecting it. Of these and several other methods, the last 2 were found most generally useful.

Average roughness figures, and profiles, are given for a wide variety of finishes on steels of varying carbon content, cast iron, red brass and Lautal.—H. W. Gillett (6)-B-

Physical Testing of Copper and Copper-rich Alloys in the form of Thin Strip. MAURICE COOK & EUSTACE C. LARKE. (I. C. I. Metals, Ltd.) *Institute of Metals, Advance Copy* No. 565, Sept. 1931, 17 pages.

Seven references. The sheets tested were rolled by commercial methods to thicknesses of 0.060, 0.040, 0.020 and 0.010 in. They were tested as annealed, reduced 9, 28 and 60% by cold rolling. Consistent results were obtained by the tensile test in all but the 0.010 in. samples. Some of the 0.010 in. samples gave erratic results, probably on account of poor alignment in loading. Of the several hardness testing methods used the diamond pyramid was considered to be the most satisfactory. Cupping tests give an indication of the workability, but the results by different machines vary too greatly to permit the inclusion of this test in specifications. Several tables give the detailed results of the tests, which include tensile, Brinell (1 mm. ball—5 kg. load), diamond hardness (pyramid with 10 kg. load), Rockwell hardness for 100 kg. load—1/8 in. ball, 100 kg. load—1/16 in. ball and 60 kg. load—1/16 in. ball, Schuchardt and Schütte hardness, scleroscope, with 3 mm. steel ball and with diamond tipped hammer, Erickson ductility, Avery ductility and Olsen ductility tests. JLG(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

The Endurance Strength of the High Quality Structural Steel St52. (Zur Frage der Dauerfestigkeit des hochwertigen Baustahles St52.) H. BUCHHOLTZ & E. H. SCHULZ. *Stahl und Eisen*, Vol. 51, July 30, 1931, pages 951–961.

Report of the Research Institute of the Vereinigte Stahlwerke, Dortmund. This investigation compares the endurance properties of the German structural steels, No. 37 and No. 52 and a 3% Ni steel. In testing smooth round bars, steel 52 showed an endurance strength by 50% higher than steel 37. Notches, holes and sharp changes in section increase the yield point and the tensile strength of all 3 steels but the alternating strength is essentially decreased. Very deep notches increase the yield point of the steels 37 and 52 to about 2.4 times the yield point of un-notched specimens. The alternating strength decreases to 40–50%. GN(6f)

Maximum Stress: Its Influence on Cost and Service Life of a Structure. EVERETT CHAPMAN. *Journal of the American Welding Society*, Vol. 10, Sept. 1931, pages 19–22.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Small areas of localized stress are causes of fatigue failures which fix the useful life of a structure. Photo-elastic examination lends itself readily to the determination of the location and magnitude of these sore spots, while its greatest value lies in checking the remedy. These areas of stress concentration occur at some change in contour. Contour changes should be gradual. Machine structures fabricated by welding are very likely to include many areas of high stress concentration. It is necessary in dynamically loaded structures to anneal the piece thoroughly after welding. Article includes photoelastic pictures showing relation of contour to stress concentration. TEJ(6f)

Endurance Strength of Welded and Soldered Bicycle and Motorcycle Frame Pipes. (Dauerfestigkeit von geschweissten und gelöteten Fahrrad- und Kraftrad-Rahmenrohren.) K. BAUMGAERTEL & K. BRUESER. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 204–208; Sept. 1931, pages 216–220.

A very comprehensive investigation of the resistance of bicycle frames built up of pipes to vibration stresses. The article must be referred to for the details of the results. All tests were made on the Foeppl endurance testing machine. Results are given in tables and micrographs. Ha(6f)

Endurance Tests of Acetylene Welds. (Ueber Dauerprüfungen von Azetylen-Schweissungen.) BAUMGAERTEL. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 27–37.

Descriptions of the bending machines of Schenck, Foeppl and of the Woehler Institute, that of Foeppl-Heydekampf and the bending-oscillating machine of the Maschinenfabrik Augsburg-Nürnberg. The results of a number of tests are tabulated. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 172. Ha(6f)

Endurance Properties of Some Well-Known Steels in Steam. T. S. FULLER. *Preprint* No. 8, *American Society for Steel Treating*, Sept. 1931, 15 pages.

See "Endurance of Alloy Steels in Steam," *Metals & Alloys*, Vol. 2, Sept. 1931, page 193. HWG+WLC(6f)

The Effect of Surface Conditions Produced by Heat Treatment on the Fatigue Resistance of Spring Steels. G. A. HANKINS & M. L. BECKER. (National Physical Laboratory.) *Iron & Steel Institute, Advance Copy* No. 9, Sept. 1931, 42 pages.

Previous work had shown that the fatigue limit of heat treated springs was only a fraction of that found in polished specimens. Experiments were conducted to determine whether or not this effect was due to surface cracks or to decarburized surfaces. A Si-Mn and a Cr-V steel was used. No cracks could be found in oil quenched specimens, and it appeared as though surface cracks were not responsible for the lowered fatigue resistance. Intentionally decarburized specimens, however, had a low fatigue limit, and it was evident that decarburization could explain the lowered endurance values in specimens containing the surface resulting from quenching. Decarburization resulted from the ordinary heat treatment, and even this slight carbon removal halved the fatigue limit. Several methods for avoiding decarburization were tried. When small specimens were heated in a neutral or CO atmosphere for quenching their fatigue limit was as high as that for ground and polished specimens. As commercially practicable treatments, it was found that heating in graphite powder or in a NaCN bath were satisfactory. The latter method of heating resulted in a higher fatigue limit than that in polished samples, due to C or N absorption. Other salt baths containing some cyanide were fairly satisfactory. Fatigue tests were made both on rotating cantilever and reversed bending machines. Values are listed in an appendix. Contains 7 references. JLG(6f)

Raising the Endurance Limit by Surface Pressure. (Das Oberflächendrücken zur Erhöhung der Drehschwingungsfestigkeit.) PAUL BEHRENS. *Metallwirtschaft*, Vol. 10, May 29, 1931, pages 431–435.

Contains 2 references. A special apparatus was developed consisting of 4 rolls mounted on a framework by which uniform pressure can be exerted on metal bars. Samples of 4 steels, 3 brasses and Elektron metal were subjected to pressure and then tested for endurance limit. In every case, a considerable increase was obtained. The first steel showed an increase of 21% in endurance limit with 5 kg./roll pressure. With 40 to 60 kg., a maximum of 42 to 50% increase was obtained. In open-hearth steel the maximum increase was 29% at 15 kg./roll; in Cr-Ni steel 24% at 60 kg.; in Cr-Mo steel 12% at 80 kg. In the first brass 11.5 to 16% at 40 to 60 kg.; in the second brass 16 to 33% at 5 to 10 kg., but only 4% at 20 kg. In the third brass the increase was irregular. In Elektron, the maximum increase was 38% at 40 kg./roll. CEM(6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Cleaning of Metals Before and After Plating. OTTO H. LOVEN. *Metal Industry*, N. Y., Vol. 29, July 1931, pages 291–292; Aug. 1931, pages 338–340.

Correct cleaning is necessary for good chrome plating. Inhibitors such as calcined soot for brass and salt for steel, prevent the pickles from attacking the base metal after the scale is removed. Boiling hot water should be used to rinse off alkaline cleaning solutions. The subsequent tarnish film is removed by 5% cyanide solution for brass and 10% hydrochloric acid solution for steel. After plating, 2 rinses should be carried out in running water heated to 125–180° F. PRK(7a)

Nickel Plating for Mass Production. N. R. LABAN. *Chemical Age*, Vol. 23, Sept. 6, 1930, pages 14–15; *Electroplaters' & Depositors' Technical Society Preprint*, 1930, 8 pages.

In a paper before the Electroplaters' & Depositors' Technical Society, the author describes experiments on Ni deposition at high current density claiming advantages of speed and better quality deposits over Ni deposition at low current density. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 81. VVK+LCP (7a)

On the Throwing Power of the Solution for Electroplating. SEIJI KANEKO. *Journal Society Chemical Industry*, Japan, Vol. 34, Apr. 1931, page 135B.

A formula is made for the study of the throwing power of the solution for electroplating. A relation is deduced from the formula; the equation shows that the more uniform deposition is obtained by increasing the distance between electrodes, by decreasing the specific resistance or by increasing the value of $(\partial v_l/\partial I)$. MAB(7a)

The Separation of Tungsten from Gaseous Compounds and Its Application. (De Afscheiding van Volfraam uit Gasvormige Verbindingen en hare Toepassing.) J. A. M. VAN LIEMPT. J. Muusses, Purmerend, 1931. Paper, 6 × 9½ inches, 117 pages. Price 4.00 Fl.

Von Wilamowitz, in his recently published "Reminiscences," states that progress in science is greatly advanced by the publication of special publications more comprehensive than the usual run of journal articles. From this point of view, Dr. van Liempt who, for a number of years, has been on the staff of the Research Laboratories of Philips' Lamp Works at Eindhoven (Holland), has performed a distinct service by publishing a small volume dealing with the theory and practice of tungsten plating by decomposition of gaseous tungsten compounds.

The subject matter is divided into 6 chapters followed by a brief summary (in English). Chapter I contains a sketch of the electrolytic and the gaseous tungsten plating process. The author points to the fact that a complete, unbiased story of the electric lamp still has to be written. Chapter II deals with the preparation and properties of WO_2Cl_2, $WOCl_4$ and WCl_6. Van Laar's theory of the additivity of the van der Waal's constants $\sqrt{a}$ and b is applied to these and to other tungsten and molybdenum compounds. The results obtained indicate that W and Mo atoms have no external forces left in WCl_6, WF_6 and MoF_6. In Chapter III, the equilibria $W + 3Cl_2 \rightleftharpoons WCl_6$ and $WCl_6 + 3H_2 \rightleftharpoons 6HCl + W$ are discussed in connection with the practice of tungsten plating by decomposition of WCl_6. The next two chapters give an outline of the practice and the various applications of tungsten and molybdenum plating. It is interesting to note that the author's experiences with uni- and polycrystalline tungsten wires do not, in many cases, lend support to Tammann's assumption of inter-crystalline impurities as the *only* agents which prevent coalescence of adjacent crystallites. The last chapter contains measurements on the diffusion constant in single crystals and in polycrystalline material.

Apart from some minor errors, there is only one criticism that the reviewer feels inclined to make, viz., the information is largely based on the work of the author and his co-workers and that of Dutch and German investigators. If Dr. van Liempt should decide to publish an English version of his researches which have appeared in Dutch and German periodicals, it might be advisable to include references to non-European literature. Of the American authors, Langmuir is the only one who is frequently quoted.—H. S. van Klooster (7a)-B-

Tungsten Bows to the Plating Bath. COLIN G. FINK. *Scientific American*, Vol. 145, Oct. 1931, page 231.

The author is head of the division of electro-chemistry at Columbia University. The first attempts to plate W were made by a German chemist, Zettnow in 1867. He used a bath of molten sodium tungsten and succeeded in obtaining a tungsten oxide by electrolysis, but failed to make pure W. Recent developments consist of passing an electric current through an aqueous solution of sodium tungstate. Deposits of metallic tungsten are successfully produced on a variety of metals, including brass, Cu and Fe; also C. The W deposit is smooth, hard and coherent, having a high luster. The sodium carbonate solution, to which tungstic acid has been added, is in most respects easily made up; it is neither poisonous nor corrosive. The salts can be readily obtained on the market and in a pure condition; the W deposit produced is clean and bright; no addition agent, such as glue is necessary. W is considered, to-day, one of the key metals of civilization. On the basis of annual tonnages the world, output is less than one-third that of Ni, and only about ten-fold that of Au. However, due to such fundamentally economic products as W alloy steel and W filament lamps, W to-day occupies fifth place among the first ten essential metals of modern civilization. The outstanding valuable chemical and physical properties of the metal and its alloys and compounds, such as, for example, the metal's resistance to severe corrosive agents, including hydrochloric acid and the extreme hardness, second only to the diamond, that can be brought about by the addition of small percentages of other elements to the W, ensure for the metal, its alloys and compounds a far reaching future development. To be deprived of W would cripple a dozen industries, including the lighting industry, the steel industry and radio. WAT(7a)

High Capacity Nickel Baths. (Hochleistungsnickelbäder.) K. ALTMANSBERGER. *Oberflächentechnik*, Vol. 8, Sept. 1, 1931, page 185.

Quick plating baths work with moving cathodes and a temperature above 50° C. The composition of such a bath of 100 l. is given as follows: 32 kg. nickel sulphate (64 g. Ni in one liter), 5 kg. sodium citrate, 1.5 kg. magnesium sulphate, 1.7 kg. boric acid, 1 kg. ethyl sulphate of sodium, 130 g. citric acid, 100 g. HCl; concentration 21° Bé, pH 5.2–5.8, temperature 45° C., voltage 3.5–4.5 volts, current density 1.5–2.0 amp./dm.², plating time ½ hr. Supervision must extend to checking the pH number, density Bé degrees) and content of Ni. The latter is determined titrimetrically every week and takes only 5 mins. A few suggestions are given for procedure in case complications should arise. Ha(7a)

Correcting Engravings by Projected Electrolyte. WILLIAM E. BAILEY. *Metal Industry*, N. Y., Vol. 29, Aug. 1931, pages 344–345.

By projecting a solution containing 159–200 g./l. $CuSO_4$, $5H_2O$ and 50–100g./l. H_2SO_4 onto an inclined Cu plate and making it either anodic or cathodic, using voltages around 15 and current densities around 800 amps./ft.², Cu can be locally removed and replaced ready for re-engraving. PRK(7a)

INDUSTRIAL USES & APPLICATIONS (9)

Merchant Ships of High Elastic Limit Steel. F. G. MARTIN. *Metal Progress*, Vol. 20, Aug. 1931, pages 65–67.

The author described the application to ship building of high elastic limit steel, produced by air cooling from 850° F. WLC(9)

Laying Rails by Heats. H. H. MORGAN. *Railway Age*, Vol. 90, June 20, 1931, page 1191.

A very brief article discussing the advantages of laying rails of one heat together, instead of using the present system of laying them hundreds of miles apart. A closer survey might be kept of the service record. Physical mechanical properties vary less in one heat than in several heats, thereby insuring better joining and matching. Failures due to faulty heats would not be so widely scattered. Costs would not be reduced in replacements but the number of joints between new and worn rails would be less. The article points out that the railroads in the long run would profit by such a procedure. WAT(9)

Colloidal Platinum and Its Behavior as a Typical Acidoid Sol. S. W. PENNYCUICK. *Journal American Chemical Society*, Vol. 52, Dec. 1930, pages 4621–4635.

Experiments are quoted which show that the whole of the colloid surface appears to be coated with a layer of oxidized platinum. On passing hydrogen the oxide layer is reduced and the acidoid properties disappear. On repassing oxygen or air the acidoid properties are recovered. All the reactions of colloidal platinum are intimately connected with the acidic nature of the surface. MEH(9)

Light Weight Alloys in Aircraft Enignes. E. F. LAKE. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, pages 508–511; *Metal Industry*, London, Vol. 38, Jan. 23, 1931, pages 113–115.

Development of light alloys much tougher than cast Fe and equalling some of the steels in physical properties are being used in aircraft engines, due also to being much lighter than steel. Connecting rods are made of duralumin and when correctly heat treated it is possible to get a tensile strength of 70,000 lbs./in.^{2} and elastic limit of 56,000 lbs. with an elongation of 15% in 2 in. and Brinell hardness of 120. Crankshafts are from a medium Cr-Ni steel. Cylinder heads are of Y-alloy produced by adding 2.00% of Ni and 1.50% Mg to Al alloy containing 4.00% of Cu. Mg alloys are 38% lighter than Y-alloys and show indications of being a competitor. VSP(9)

Thermal Efficiencies of Aluminum Saucepans. C. LANDRETH & R. O. HUTCHINSON. *Journal Home Economics*, Vol. 21, Aug. 1929, pages 599–604; *Journal Chemical Education*, Vol. 7, Jan. 1930, page 194.

Relative efficiencies of light and heavy aluminum ware were determined by: (1) rate of heating; (2) retention of heat; (3) proportion of water evaporated during cooking process: (4) durability; (5) cost. As results of this study it may be assumed that: (1) the thermal efficiencies of light and heavy cooking utensils are the same; (2) the loss of water by evaporation is a function of the fit of the lid and not of the thickness of the wall; (3) the difference in cost between well-constructed light and heavy aluminum ware can only be justified on the grounds of greater durability. (9)

Some Added Uses for Lead Pipe. C. L. MANTELL. *Heating, Piping & Air Conditioning*, Vol. 3, July 1931, page 635.

A very brief note to indicate a new use for lead pipe. To obviate the necessity of stocking a supply of spare gaskets of odd shapes, a coil of small size medium weight lead pipe may often supply the need. If lack of space prevents such thickness the pipe may be split. Asbestos rope packing inside a piece of lead pipe provides a very serviceable gasket. The difficulties encountered when removing an old gasket are lacking when such a gasket is used. WAT(9)

Modern Materials and Material Problems in the Construction of Chemical Equipment. (Neuzeitliche Werkstoffe und Werkstofffragen des Chemischen Apparatebaues.) KESSNER. *Chemische Fabrik*, Vol. 4, May 27, 1931, pages 233–238; June 3, 1931, pages 250–252; June 17, 1931, pages 266–269.

Contains 12 references. A review of the chemical resistance, mechanical properties, technical workability and welding properties of steel, iron, stainless steel, lead, nickel, Ni alloys, aluminum, heat resistant metals and coatings, parkerizing and enameling processes, hard rubber, synthetic resins and a new material called prodorit. CEM(9)

Light Alloys in Engine Construction. E. F. LAKE. *Aviation Engineering*, Vol. 6, July 1931, pages 15–17.

One of the aircraft engines using light alloys most freely is the American Ensign engine. All the outside parts of this engine are made of light weight alloys, except that part of each cylinder that is rubbed by the piston rings. This is cast iron because nothing has yet been discovered that will glaze over and withstand frictional wear like cast iron. Inside the crankcase, the crankshaft, camshaft and gears are still steel because they get strains and stresses that are beyond the strength resistance of any light weight metals or alloys so far discovered. The cylinder head is made from the Y-alloy produced in England by adding 2% of Ni and $1^1/_4$% of Mg to the aluminum alloy containing 4% of Cu. Its weight is 185 lbs./ft.^{3}, which is about $^2/_5$ of the 450 lbs. that cast iron weighs. It has double the tensile strength of cast iron and is much tougher. A duralumin connecting rod is used on this engine because it is $^1/_3$ of the weight of steel/ft.^{3} Its elastic limit of 55,000 lbs./in.^{2}, however, is but $^1/_3$ that of the best grades of alloy steels and if that were the only factor to consider the sectional area of the dural connecting rod would have to be 3 times as great to produce the total strength and nothing would be gained. But stiffness is a factor that must be considered and to machine chrome-nickel steels down to the thinness and lightness their high elastic limit would warrant, would make them too springy or flexible. To complete the light weight motive of this engine, all parts of its De Palma supercharger were made of the same Y-alloy that is in the cylinder heads described above. WHB(9)

Metal Rotors of Autogiro Hinged for Stability. BIRAN VON LINDEN LANSDOWNE. *Iron Age*, Vol. 128, July 30, 1931, pages 302–303.

Hinging of blades has the important effect of eliminating most of the bending stresses. Blades of rotor are made of elliptical steel tubing. The flexibility of the blades is an important element of autogiro characteristics and is rendered possible only by means of hinging. Hinging also eliminates gyroscopic action of rotor. VSP(9)

Airplanes must be Safe. ROBERT E. JOHNSON. *American Machinist*, Vol. 74, Feb. 26, 1931, pages 345–348.

The Boeing plant at Seattle, Wash., manufactures both commercial and government planes. These are both inspected by factory inspectors and the government planes by government inspectors also. Discusses parts tested and gives some requirements. Table gives chemical and physical requirements of metals used in construction of the airplanes. RHP(9)

Correlating Theory and Practice in Pressure-Vessel Design. NORMAN W. KRASE. *Chemical & Metallurgical Engineering*, Vol. 37, Sept. 1930, pages 540–543.

Reviews principles of design, discusses selection of materials, and outlines methods of fabrication and of testing pressure vessels. MS(9)

Cast vs. Welded Flywheels. ROBERT E. KINKEAD. *American Machinist*, Vol. 74, Apr. 2, 1931, pages 547–548.

Welded steel flywheels are more economical than cast only when the speed or the diameter may be increased. This applies only to the plain disk type of steel wheel. RHP(9)

Piping Reliability of Importance in Power Plant Near Arctic Circle. R. A. HANRIGHT. *Heating, Piping & Air Conditioning*, Vol. 3, Sept. 1931, pages 741–745.

On the west coast of the Hudson Bay, almost within fringe of the Arctic Circle, the first unit of an eight million bushel grain elevator is being constructed for the Department of Railways and Canals, at Fort Churchill, scheduled to be ready for operation Sept. 1, 1931. A power plant will supply the electrical energy to operate motors driving the elevator machinery and the steam for the dryers and heating. The plant contains 3 boilers, two 600 hp. units and one 300 hp. unit all working at 275-lb. pressure, and delivering superheated steam at 650° F. Great care has been exercised in the selection of the equipment especially the piping. The plant will operate 3 months each year. All piping has been carefully installed, particular attention being given to the ease of draining when the plant is not in operation, as winter temperatures of −50° F. are not uncommon. WAT(9)

Electric Steel Rails. (Rails fabriqués au four électrique.) E. HOUBAER. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 385–387.

Raising the C content of rails above 0.55–0.65% is undesirable from the point of view of ductility. This C gives too soft a steel, so that either heat-treatment or the introduction of suitable alloying elements is called for. A homogeneous rail is more desirable and so alloying is the better procedure. To produce such rails and to meet rail specifications one is more certain of getting uniform results from heat to heat by duplexing converter metal in the electric furnace than by using the open-hearth. The compact structure of electric steel makes it better fit for rail use. HWG(9)

The Use of Aluminum in Roofing. (L'impiego dell' alluminio nella copertura di edifici.) H. FROIDERAUX. *Metalli Leggeri*, Vol. 1, May–June 1931, pages 35–40.

Aluminum tile are reported to have been successfully used in the United States, but favorable European experience is lacking. Favorable results have been had with roofing of Al sheet 0.1–0.3 mm. thick, fastened to a wooden support by a bituminous adhesive in the fashion sometimes used for copper sheeting. Special joints are made between sheets. This type does not have great mechanical strength, and has to be laid with care. The most used type is a roofing of sheet 0.6–0.8 or 1.0 mm. thick with grooved joints applied much as is the case with copper or zinc roofing with due regard to requirements as to thermal expansion. The material is 99.2% or, better, 99.5% Al or else an Al Mn alloy sheet. It is claimed that in atmospheres saturated with ammonia and combustion gases, comparative lives have been: Zn, 3 to 4 years; Cu, 6 years; Al, 12 years. The gage of sheet compared is not stated. It is also claimed that Al is the most economical metallic roofing, all things considered. HWG(9)

Development of Steel Construction in the United States of America. (Die Entwicklung des Stahlbaues in Amerika.) O. VON HALEM. *Stahl und Eisen*, Vol. 51, June 1931, pages 734–739.

The artic e reviews the recent development of steel frame construction in the United States. GN(9)

Electrically Welded Construction. (Elektrisch geschweisste Konstruktionen.) H. HINTZ. *Stahl und Eisen*, Vol. 51, Feb. 26, 1931, pages 258–260.

Report 170 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The article deals with the application of electric welding in machine construction, as, for instance, in the case of cranes, dredges, drums, frames, large gears, etc. The saving of weight is the greatest advantage of electric welding. GN(9)

The Welding of Steel Structures. (Die Schweissung im Stahlbau.) A. HILPERT. *Die Bautechnik*, Vol. 9, July 24, 1931, pages 177–180.

Describes the progress in welding of steel structures of the past $1^1/_2$ years, and explains the mechanics of welding and the places where welds are used. MAB(9)

Welding in the Heating Industry. J. F. HUMPHREY. *Welder*, Vol 2, Aug. 1931, pages 19–22.

Description and illustrations of welding of bends, pipes, pipe lines, etc., and of equipment necessary for welding in the field. Ha(9)

Using Steel in Building the Private Residence. THOMAS J. FOSTER. *Iron Age*, Vol. 128, Aug. 6, 1931, pages 370–398.

This article is the first of a series telling what has been done and outlining some of the developments which the future is likely to bring forth. The importance of the use of steel in relation to private residence is in proportion to its ability to make possible an improved construction at a reduced cost. VSP(9)

Wear Allowances and Tolerances on Gages. E. J. BRYANT. *Metal Stampings*, Vol. 3, Oct. 1930, pages 895–896.

Abstract of a paper read before the Society of Automotive Engineers. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 39. MS(9)

Care of the Detachable-Blade, Metal Propeller. FRANK W. CALDWELL. *Aviation*, Vol. 30, June 1931, pages 357–359.

Propellers made of magnesium alloy are beginning to come into use. This material weighs only 6/10 as much as the aluminum alloy and has splendid fatigue properties. It is, however, subject to corrosion if exposed to salt water or salt spray and must be thoroughly protected from contact with them. The following procedure has been found to be fairly satisfactory as a means of protection. The blades are first treated in a neutral magnesium phosphate solution, which results in a coating somewhat similar to the Parkerizing of steel parts. On top of this coating, 2 or 3 coats of Duco, or enamel are applied. The propeller should be wiped off with oil every day, or after each flight. By the use of these precautions, it is possible to take advantage of the light weight of this material even for operations near the sea coast. (9)

The Modern Steel Casting. R. L. COLLIER. *Iron & Steel of Canada*, Vol. 14, Mar. 1931, pages 57–59.

A brief article, calling attention to the advantages possessed by steel castings in engineering practice. OWE(9)

Requirements on the Material and Production of Modern Boiler Design. (Aufforderungen an Werkstoff und Herstellung in neuzeitlichen Dampfkesselbau.) E. BLOCK. *Glückauf*, Vol. 67, Apr. 18, 1931, pages 524–527; Apr. 25, 1931, pages 551–558.

The present trend of using higher temperatures and pressures in steam boilers makes imperative special attention to the mechanical properties of mild steel which is the most important material for the construction of boilers. The author discusses the correct treatment, points out defects which may arise in it due to improper handling and indicates ways and means for their prevention. Guarantee tests on the principal parts of the boiler, shell, fittings and rivets are discussed. The need for careful supervision of the construction is emphasized and illustrated by an example. Ha(9)

Zinc and Zinc Alloys Used in the Automotive Industry. ROBERT M. CURTS. *Automotive Industries*, Vol. 65, Jan. 1931, pages 169, 172.

See *Metals & Alloys* Vol. 2, Sept. 1931, page 176. DTR(9)

Copper and Its Alloys in Present Armaments. (La cuivre et ses alliages dans les armements actuels.) V. CHEILLY. *Cuivre et Laiton*, Vol. 4, July 15, 1931, pages 315–317.

An enumeration of applications in the production of small and large arms and munitions. Cu is recommended for much more extended use. Ha(9)

HEAT TREATMENT (10)

Heat-Treatment of Aircraft Parts. HORACE C. KNERR. *American Machinist*, Vol. 74, Feb. 26, 1931, page 369.

Abstract giving tables taken from a paper in the Proceedings of the American Society for Testing Materials, Vol. 30, Pt. 2, pages 154–170. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 849. VSP(10)

Rolling and Heat-Treatment of Automobile Sheet. (La fabrication et les traitements thermiques de la tole pour l'industrie automobile.) A. T. KATHNER & P. DAMIRON. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 299–311. 15 references, 15 figures.

Traces the evolution of continuous normalizing. Micrographs of grain size suitable for different grades of body and fender stock are shown, with tensile, Rockwell and Erichsen data. See *Metals & Alloys*, Vol. 2, Apr. 1931, page 81. HWG(10)

The Bright Annealing of Copper and Its Alloys. O. S. HASKELL. *Electrical Manufacturing*, Vol. 8, Aug. 1931, pages 41–42.

The first of a series of 2 articles. Cu is crystalline in structure and, normally, the crystals approach a spherical shape. When the metal is cold worked, the crystals or grains are distorted out of their normal shape and the metal tends to become brittle and hard. After wire drawing, for instance, the crystals are no longer in their normal spherical shape, but have been drawn out into long, thin threads more or less cylindrical. When heat is applied to the metal in this condition, new grains are formed which grow in various lengths of time at different temperatures to normal shape. Pure Cu will anneal at a lower temperature than any of its alloys. The greater the amount of the other metals in the alloy, the higher will be the temperature required, within limits. Metal which can be annealed in one minute at a high temperature, can also receive the same anneal in one hour at a much lower temperature. This short résumé of the annealing process makes no attempt at completeness and is given only to show the necessity for wise and careful temperature control. WAT(10)

Quenching, Annealing and Drawing. III. Results. (Trempe, Recuit, Revenue. III. Resultats.) LEON GUILLET. Dunod, Paris, 1930. Paper, $6^1/_2 \times 10$ inches, 490 pages. Price $7.50.

The third volume of this series is not limited to any definite group of readers or subdivision of metallurgy. Conceived to furnish a complete presentation of the changes occuring when metallic bodies are subjected to thermal treatment it gives more than bare figures. Its background is the whole store of knowledge accumulated since the birth of the science and checked by a leader of metallurgical thought. Any given subject becomes here a vivid picture of the problem with all its difficulties, possibilities and complications standing in a sharp relief.

Beginning with pure iron the work passes over carbon and alloy steels, discusses cast and malleable irons and comprehensively covers the non-ferrous field. The latter occupies $^1/_2$ the book, and $^9/_{10}$ of it deals with copper, aluminum and nickel alloys. In its scheme the volume follows a pattern which has become almost classical but with an important difference in that the generally adopted standards of relative values are often revised. If a point appears interesting, and Professor Guillet is eminently qualified to decide this, it is treated with fullness seldom to be found elsewhere, particularly in treatises of encyclopedic character to which the present belongs. There is no hesitation when many pages are required for illuminating the effect of heat treatment on strained metals or, for example, a description is needed of some new system like Fe–Cr–Al, Al-Ti or Cu–Ge. The industrial importance of many alloys is reflected in their minutely detailed treatment. The thorough knowledge of the human side of the question permitted the writer to omit much superfluous data, but with the confidence that the gaps so produced would be filled easily by anyone even slightly conversant with the subject. One can be certain that newness or obscurity of a process by no means will prevent its presence in the pages of this volume, provided it deserves some attention. High temperature annealing of steel castings and modern methods for heat treating of rails serve as good examples. Everything of interest in the literature is recorded bringing the references given to papers published in 1930. It must be noted that treatments involving any chemical changes are not included here.

Among a very large number of data it is difficult to find a single error. Recommendations of eight hour pickling for patented wire, of the use of a blowtorch for heat treating riveting sets or some other similar statements become striking only after crossing the ocean. If there is a point of complaint it would be found in a somewhat individualistic opinion regarding the importance of some subjects. Thirty lines assigned to silicon transformer sheets, the absence of data on annealing high carbon steels, ninety photomicrographs of high speed steel compared with thirty-eight for all other alloy types illustrate this.

The plan of the work and the treatment of the material bear witness to the exhaustive knowledge of its author, much thought and a remarkable facility for clear expression. Only once in a while a jarring note is felt. A quarter of a century is a long period in a rapidly growing science, and one feels that heat treating data as old as that introduced even occasionally in a modern book cannot fail to affect the harmony of the whole.

The highest aim of a good technical book is giving correct information. Then comes the range of the subjects covered and an important place is occupied by the manner in which the data are conveyed to the reader. An author who can meet helpfully an audience ranging from the man spending all his time in heat treating, say, cluster gears, to the college professor dealing daily with the whole gamut of steels and non-ferrous metals is very fortunate in his achievement. These books are rare, they leave a lasting impression on metallurgical literature and they are welcomed unanimously by the profession. Trempe, Recuit, Revenu is one of them.—John D. Gat (10)-B-

Tempering of Quenched Steels. (Contribution a l'étude du revenu des aciers trempés.) P. CHEVENARD & A. PORTEVIN. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 263–282.

Includes discussion, 72 figures and 11 micrographs. Five high C, high Mn or Cr steels were studied in detail, these being chosen to give various proportions of austenite and martensite on quenching. Dilatometric and thermomagnetic tests were made, supplemented by measurements of resistance, of hardness and by metallographic examination. Results are plotted in great detail for various quenching and drawing temperatures. The tempering of austenite comprises 3 reactions, change to cementite plus a lower C austenite, change to cementite plus martensite and change to martensite. That of martensite is a progressive decarburization of the solution of C in α-iron, spread out over a long temperature interval. HWG(10)

Decarburization and Desulphurization of Steel and Pig Iron by Hydrogen. (Die Entkohlung und Entschwefelung von Stahl und Roheisen durch Wasserstoff.) J. CIOCHINA. *Stahl und Eisen*, Vol. 51, Aug. 13, 1931, pages 1024–1026.

A rapid method for the decarburization and desulphurization of white pig iron and steel by means of hydrogen containing 0.3–0.5% O_2 is described. The experiments were carried on at various temperatures. 12 steels with C contents between 0.27 and 0.86% were decarburized for 3 hrs. at 1250° C. The best temperatures of desulphurization are between 1400° and 1450° C. By means of the method described, it was possible to transform white pig iron to gray cast iron and to make Armco-iron from electric steel. GN(10)

Thermomagnetic Investigation of Tempering of Quenched 0.75 Percent Carbon Steel. GEORGE A. ELLINGER. *Bureau of Standards Journal of Research*, Vol. 7, Sept. 1931, pages 441–451; *Research Paper Bereau of Standards* No. 350.

Previous investigators have shown that martensite and retained austenite are present as constituents of quenched carbon steels. A study of the decomposition of these constituents in water quenched 0.75% C steel has been made by means of thermomagnetic analysis. An astatic magnetometer was used to show changes in magnetization of specimens at various temperatures and these magnetization changes have been interpreted in the light of constitutional changes in the steel. Immediately upon the application of heat, an increase in magnetization took place, which is believed to represent stress release, caused by the precipitation of C from the supersaturated solid solution of C in α-iron. The degree of tempering is believed to be dependent upon temperature and time, the first stage being completed at 200° C. in about $6^1/_2$ hours. The precipitated C is believed to combine with iron in the range between 200° and 300° C. to form iron carbide. This combination is progressive with time, being completed at 300° C. in about one hour. From 300° to 700° C. no further magnetic changes were noted upon holding at constant temperatures, consequently no further constitutional changes were believed to take place in this range, but the carbide apparently coagulated to form larger and larger particles. An increase in magnetization at about 235° C. was believed to indicate the decomposition of austenite, the decomposition being completed in about 45 minutes at that temperature. WAT(10)

Hardening (10a)

The Quenching and Aging of Low-Carbon Steels. (Trempe et vieillissement des aciers extra-doux.) A. BATES. *Comptes Rendus*, Vol. 193, July 6, 1931, pages 35–38.

In an article accompanied by 3 diagrams, the author discusses the results of a series of experiments carried out on basic open-hearth steel containing 0.026% C. The characteristics of the curves shown in 2 of the diagrams are explained by the author in terms of the variable solid solubility of cementite in any α-Fe. The author has also experimented on a series of bars of steel containing different amounts of C, which were prepared by decarburization in H at 925° C. He found that steel containing less than 0.012% C could not be hardened by aging and, on the basis of this observation, suggests that this percentage of C represents the limit of solubility of cementite in α-Fe at room temperature. OWE(10a)

The Mechanism of Steel Hardening. (Der Mechanismus der Stahlhärtung.) G. KURDYUMOV & G. SACHS. *Naturwissenschaften*, Vol. 18, May 30, 1930, page 534.

See *Metals & Alloys*, Vol. 2, Sept. 1931, page 177. WHB(10a)

Annealing (10b)

Continuous Electric Furnace for Annealing Metallic Strips. (Four electrique continu pour recuit des bandes metalliques.) OTTO JUNKER. *Journal du Four Electrique*, Vol. 40, July 1931, pages 278–280.

In annealing sheets or strips until now it was necessary either to pile the former or to coil the latter before introducing them into annealing furnace. This resulted in a pronounced temperature lag between the inside and outside layers of the metal. By unrolling the strip and passing it through the heated zone of a furnace it is possible to heat it throughout almost instantaneously. An electric furnace was designed on this principle with the capacity of 6 tons of 0.2 mm. × 30 mm. brass strip per 24 hrs. The furnace proper is 500 mm. wide permitting the simultaneous passage of 4 strips. It is kept at 800° and permits excellent regulation of the annealing treatment by changing the speed of the strip. At the present these furnaces are used as a part of units including, besides strip handling equipment, cooling, pickling, brushing and drying devices. The furnace is well insulated and the current consumption corresponds to an effiiciency of 85–92% calculated on the theoretical requirements for heating the strip. Structural details are given. JDG(10b)

Applications of the Electric Furnace for Non-Ferrous Metals, with Special Reference to the Bright Annealing Process. H. C. KLONINGER, G. KELLER & H. MEUCHE. *Institute of Metals, Advance Copy* No. 575, Sept. 1931, 18 pages.

Discusses the principally used bright-annealing processes, which include the Kenworthy, Heddernheim, Brown Boveri and Grünewald processes. It is shown that considerable improvement in bright annealing processes have been made in the last few years. The operation of the Grünewald process is described in detail. JLG(10b)

The Annealing of Foundry Hooks and Chains. WILFRID DUNKERLEY. *Foundry Trade Journal*, Vol. 43, Nov. 20, 1930, pages 355–356.

Foundry hooks and chains are heated up to 700° C. for 2 or 3 hrs., then allowed to cool in the furnace. Describes tests conducted. Experiments show that temperature of 950° C. should be used in preference to that of 700° C. if maximum strength and minimum grain size is required. Low temperature annealing effected little or no improvement in the strained material. Tabulates results. VSP(10b)

Composition, Temperature, Time and Control Govern Short Anneal. EDWIN BREMER. *Foundry*, Vol. 59, Aug. 15, 1931, pages 32–34.

The first of 2 articles on shortening of malleable cast Fe annealing cycles. There has been a constant search for methods whereby the annealing period could be reduced. Cites various authorities on the subject. According to Archer and White, as the temperature of anneal increases, the time necessary decreases and, at about 1500° F., the time required is 10 hours. Includes a table giving chemical and physical properties of annealed bars and several graphs. VSP(10b)

The Chemical Effect of Gaseous Atmospheres in the Bright Annealing of Metals. R. J. COWAN. *Metal Industry*, N. Y., Vol. 29, Aug. 1931, pages 333–335.

Above 800° F., brass liberates gas, one being carbon dioxide which causes tarnishing. Carbon monoxide decomposes to C and carbon dioxide. Pure H bright anneals at 1250° F., but aids the volatilization of Zn. Hydrocarbons must be broken down to H and C at 1250° F. in the presence of Fe catalyst to satisfactorily bright anneal. Decomposed ammonia must also be used at 1250° F. By adding methanol to dried flue gases, bright annealing of brass is possible at any annealing temperatures. PRK(10b)

Case Hardening & Nitrogen Hardening (10c)

The Influence of High-Frequency Electrical Oscillations on the Properties of Metals and Alloys. JULIUS GRANT. *Metal Industry*, London, Vol. 38, June 12, 1931, page 593.

The work of Mahoux in France is mentioned. Electromagnetic oscillations increase the penetration of ammonia in nitriding processes, and increase the diffusion of chromium and of carbon into iron. PRK(10c)

Correlation of the Crystal Structure and Hardness of Nitride Cases. OSCAR E. HARDER & GEORGE B. TODD. *American Society for Steel Treating, Preprint* No. 6, 1931, 22 pages.

Paper to be presented before the Boston Convention of the Society, Sept. 1931. 13 references to the literature are cited. Ingot iron, S.A.E. 1025, Cr-Al and two Cr-Al-Mo nitriding steels were nitrided and a study made of their crystal structure by X-ray defraction methods, their Vickers hardness and microstructures. Hexagonal close packed lattice was found in all samples and was accompanied by face centered cubic in all except ingot iron. Transition from surface inward is first to face centered cubic then to face centered with the α-lattice and at low depths, 0.003 to 0.004 inch, the α lattice only is found. Hexagonal close packed lattice is associated with surface brittleness. Cases without it are not brittle. Cases showing only α lattice have full hardness. WLC(10c)

The Influence of High-frequency Vibrations upon the Heat-Treatment of Materials. D. R. LEWIS. *Metallurgia*, Vol. 4, Aug. 1931, pages 126A, 126B.

A review of the work reported in *Le Genie Civil*, in which it was shown that the nitriding process could be accelerated by applying high-frequency vibrations during nitriding. With such vibrations steels can be nitrided that cannot be otherwise. Application is being made of the process in England. JLG(10c)

Case Hardening with Ammonia Gas. V. O. HOMERBERG & J. P. WALSTED. *Transactions American Society Mechanical Engineers*, Vol. 53, Jan.-Apr. 1931, *Machine Shop Practice*, pages 1–6.

The process of "nitriding" is explained, that is a case hardening under the influence of the N in ammonia gas. Steels containing varying amounts of C together with 1–1.25% Al, 1.5% Cr and 0.2% Mo were found to be especially susceptible to this treatment. The material is called Nitralloy. All parts should be heat treated before nitriding in order to obtain desirable physical properties of the core and to insure proper grain refinement because the original grain size of the material is not reduced during the nitriding operation. The depth of the hardened case increases with nitriding temperature, from 900 to 1300° F., but the hardness decreases. It is, however, possible to nitride, first at a high temperature to obtain a considerable depth and then at a lower temperature to obtain the desired surface hardness. The presence of a decarburized layer before nitriding produces a brittle case; this layer should, therefore, be removed first. Ni plating and a coating of Sn will protect parts against nitriding. Nitrided articles offer marked resistance to atmospheric, water and salt water corrosion and show excellent wearing properties, even without lubrication, against certain other alloys, notably against Nitralloy, itself and a nickel bronze. 7 references. Ha(10c)

Development of Continuous Gas Carburizing. R. J. COWAN. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 439, Sept. 1931, 17 pages.

The theoretical aspects of carburizing are discussed. It was found that if a layer of C was deposited on the parts to be carburized, CO_2 will react with the deposited C to carburize the steel. A sufficient quantity of CH_4 will prevent the CO_2 from decarburizing. A continuous gas carburizing process was developed in which the gas and the parts travelled in the same direction. The gas consists of a mixture of natural gas, propane, butane or acetylene with flue gas. The furnace may be considered as divided into 3 zones. In the first or low temperature zone, the hydrocarbons are cracked and deposit C on the steel. Regulation is such that only part of the gas is cracked. The walls are constructed of a special alloy that will not cause C precipitation. In the second or full temperature zone CO_2 (from the flue gas) reacts with the deposited C to carburize the steel. Rapid carburization occurs in this zone and leaves a too sharply defined case. In the third or diffusion zone, the C in the case diffuses into the core. The atmosphere in this zone is of little importance provided it contains sufficient CH_4 to prevent decarburization by the CO_2. Uniform results were obtained and the character and depth of the case could be easily regulated. Operation is faster than with box carburization. Contains 12 references. JLG(10c)

Development of a Continuous Nitriding Furnace. R. J. COWAN. *Fuels & Furnaces*, Vol. 8, Nov. 1930, pages 1517–1520, 1552.

Condensed from *Metal Progress*, Vol. 18, Oct. 1930, pages 93–98. See *Metals & Alloys*, Vol. 2, July 1931, page 132. MS(10c)

Recent Investigations on the Case Hardening of Locomotive Slide Bars. (Neue Untersuchungen über die Einsatzhärtung von Lokomotivgleitbahnen.) HELLMUT CRAMER. *Maschinenbau*, Vol. 10, June 18, 1931, pages 419–424.

A short preliminary discussion is followed by a description of the tests which were carried out at the Reichsbahn-Ausbesserungswerk Sebaldsbrück on case hardening of locomotive slide bars. Both solid and liquid cementation agents were used. A comparison of the value of each is given. 12 photomicrographs. MAB(10c)

The Surface Hardening by Nitrogen of Special Aluminium-Chromium-Molybdenum Steels on a Production Basis. W. H. CUNNINGHAM & J. S. ASHBURY. *Iron & Steel Institute, Advance Copy* No. 7, Sept. 1931, 14 pages.

Describes a commercial nitriding method. Protection against nitriding can be produced by coating with solder or a mixture of Al powder in water glass. Growth of the parts amounts to 0.001 to 0.006 in., and is almost independent of section. Distortion occurs only in rare instances. It can occur, however, when thin parts are nitrided only on one side. The Firth hardometer is recommended for determining the hardness of the case. The decarburized surface must be completely removed from surfaces that are to be nitrided. The nitriding steels usually contain from 0.20 to 0.55% C, depending on the properties required in the core. A nitriding temperature between 500° and 510° C. is recommended. JLG(10c)

Quenching (10d)

New Process of Quenching Steel. (Nouveau procédé de trempe de l'acier.) N. F. BOLKHOVITINOF. *Viestnik Metallopromychl*, Vol. 10, June 1930, pages 88–90; *Chimie et Industrie*, Vol. 25, Feb. 1931, pages 352–353.

Bolkhovitinof experimented with Lewis' process, which consists in heating the steel above the critical temperature and then quenching in a bath of molten salt or of oil heated to 230°. When treated in this way, the steel is at first soft; it consists of austenite, and becomes hard only about 5 min. after having reached ordinary temperature. It then expands, becomes magnetic and is transformed into martensite. Owing to this slow change in structure, all the transformations produced by the variations in volume have time to take place, which completely eliminates the usual defects of the ordinary quenching process, giving great hardness and homogeneity. But from a practical standpoint, the greatest advantage of the method lies in the fact that pieces quenched in this way can undergo all the requisite deformations and flexions in 1–2 min. after quenching. WHB(10d)

Oils Used in Heat Treating Plants. (Beitrag zur Frage der in Wärmebehandlungsbetrieben zu verwendenden Oele.) K. KREKELER & F. RAPATZ. *Archiv für Eisenhüttenwesen*, Vol. 5, Sept. 1931, pages 173–176.

The investigation shows that there are no essential differences between the various quenching oils when first in use. A longer use, however, brings about remarkable differences, which are indicated by the variable resistivity against decomposition and a variable capacity for adhering to the heat treated steel. Vegetable oil is not superior to mineral oils; there are even indications that mineral oils are superior. Oils must be especially resistant against decomposition at high temperatures. The requirements of tempering oils are given. GN(10d)

JOINING OF METALS & ALLOYS (11)

Welding and Soldering in Repairing of Machine Parts. (Schweissen und Löten bei der Reparatur von Maschinenteilen.) W. ANDERS. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 209–211.

Several examples which show the 2 kinds of parts to be joined together are illustrated. In general, parts from 4 to 15 mm. in thickness can be welded economically. For thicknesses up to 150 mm., it might, sometimes, be more advantageous to apply solder in the crevices and between parts. The preparation of the parts in using either method must be given close attention. Ha(11)

Jointing Stainless Steel Sheets by Soft Soldering and Brazing. A. EYLES. *Sheet Metal Worker*, Vol. 22, July 24, 1931, pages 440–442.

A detailed discussion of the methods, materials and procedure control required for desirable results. Compositions of soft solders and fluxes and precautions to be observed for stainless steels are described. Ha(11)

Welding & Cutting (11c)

Past and Future Growth of the Welding Industry. C. A. ADAMS. *Welding*, Vol. 2, Sept. 1931, pages 626–627, 629.

The 2 major factors contributing to the growth of the welding industry in the past 5 years are: The injection of scientific methods into the industry, accompanied by the interest of a group of highly trained technical men; and an appreciation of the superior product and the large material and labor saving made possible by welded construction. The trend of the welding industry during the next 5 years will probably be along the following lines: greater recognition by capital, management and labor; more extensive fundamental research; the further use and development of non-destructive tests for welds; wider application to all metal industries, of the non-ferrous metals and alloys, and to complicated production problems. TEJ(11c)

How to Weld the Chrome-Nickel Steels. Part 1. S. CRAIG ALEXANDER. *Welding*, Vol. 2, Aug. 1931, pages 514–517.

Structural characteristics and physical properties of "18 and 8" Cr-Ni steel are given, particularly those which have a bearing on its welding characteristics and physical properties of the welded material. Heating KA2 to 1000–1400° F. causes carbide precipitation which decreases resistance to corrosion. KA2-S, which has a low C content (less than 0.07%), is recommended for welded structures which cannot be heat-treated as a whole and where carbide precipitation is a disturbing factor. TEJ(11c)

Gas Fusion-Welding in Steel Structures. (Die Gasschmelzschweissung im Stahlbau.) K. BERTHOLD & H. KNORTH. *Die Schmelzschweissung*, Vol. 10, June 1931, pages 135–139.

Very exhaustive tests with gas-welded steel structures have shown that this method is absolutely safe and advantageous if the designer and the welder take the particular characteristics of this process into account. Methods for testing large girders, trusses, etc., are described and several examples of structures are illustrated. It is recommended that only symmetric profiles be used for construction. Ha(11c)

Influence of Gas Fusion-Welding on the Bending-Vibration Strength of Chrome-Molybdenum Steel Pipes. (Einfluss der Gasschmelzschweissung auf die Biegungsschwingungsfestigkeit von Chrom-Molybdän-Stahlrohren.) H. BIESSNER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, July 25, 1931, pages 954–956.

The exacting requirements of the vehicle and airplane industry have led to the development of a steel with 0.3% C, 0.75–1.0% Cr, 0.2–0.3% Mo. Tests to determine the bending vibration strength of welded and non-welded pipes are described. The non-welded pipes gave 24–26 kg./mm.^{2}; the properly welded tubes, 15–16 kg./mm.^{2} Dynamically strained pipes up to 2 mm. wall thickness welded with a low-carbon unalloyed welding pencil; pipes above 2 mm. with a pencil containing Cr-Mo addition. The welding flame must be neutral. The welding seam should be V-shaped with an angle of 80°. The width of the seam is of great influence on the vibration strength; for pipes of 1.5 mm. wall, 8 mm. wide; for 3 mm. wall, 13 mm. wide. Ha(11c)

Possibilities of Resistance Welding. MALCOLM CLARK. *Welding*, Vol. 2, Aug. 1931, pages 531–532, 538.

Abstract of paper presented Jan. 23, 1931, before the Youngstown, Ohio Section of the American Society of Mechanical Engineers. The author discusses method of calculating transformer capacity and the fundamentals of butt, spot and projection welding. Four examples in calculating transformer capacity are given. Spot welding of non-ferrous alloys requires much greater transformer capacity than welding of steel. TEJ(11c)

Simplified Plant Design with Welded Pressure Equipment. J. N. COMPTON. *Chemical & Metallurgical Engineering*, Vol. 37, Sept. 1930, pages 562–564.

Discusses application of welding to construction of chemical equipment. States that tightness, simplicity of design, and ease of erection and changes in the field are inherent in welded equipment. MS(11c)

The Application of Welding to Steel Construction in Germany. OTTO BONDY. *Engineering*, Vol. 131, Mar. 6, 1931, pages 322–323.

Mentions briefly progress made in recent years in using welding in steel construction. With its increasing use in Germany, official regulations covering its use were issued by the Prussian Minister of Public Safety. The following table compares these rules with those of the American Welding Society:

Country		Permissible Unit Stresses lb./in.^{2} Tension	Compression	Bending	Shear
Germany	Base Stresses	10,300	12,800	as for tension and compression	8,600
	Base Stresses + 1/3	13,800	17,200		11,500
United States		13,000	15,000		11,300

German regulations are for open-hearth steel St. 37, the breaking load of which is 23.6 to 28.8 tons/in.^{2} Balance of article deals with regulations as to the methods of welding. LFM(11c)

Aeroplane Welding in America, Methods Used in the Manufacture of Eaglerock Planes. JOS. C. COYLE. *Welder*, Vol. 3, Sept. 1931, pages 36–40.

Illustrated description of the manufacturing process used by the Eaglerock Aeroplane factory at Colorado Springs, Colo. Ha(11c)

Investigations into Economical Flame Cutting. (Untersuchungen über wirtschaftliches Brennschneiden.) C. ASSMANN. *Forschungsarbeiten auf dem Gebeite des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 49–65.

Tests made with 16 mm. and 30 mm. thick wrought iron plates cut with 99% pure O. See *Metals & Alloys*, Vol. 2, July 1931, page 133. Ha(11c)

Arc Welding Makes Possible Steel Frame House of Practical Design. A. F. DAVIS. *Journal American Welding Society*, Vol. 10, Aug. 1931, pages 10–12.

Details of construction are illustrated and explained. It is believed that this type of design will come into wide use; the cost is practically the same as the traditional wood framing. TEJ(11c)

Repair of a Small Boiler Having Become Useless by Rusting by Means of Autogenous Welding. (Instandsetzung einer durch verrosten unbrauchbar gewordenen Kleinkessels mittels autogener Schweissung.) E. BOTHMER. *Schmelzschweissung*, Vol. 10, July 1931, page 172.
Detailed description of the repair of a 6 atmosphere boiler. Ha(11c)

Electrical Resistance-Butt-Welding Machine with Clamping by Compressed Air. (Elektrische Widerstand- Abschmelz-Schweissmaschine mit Presslufteinspannung.) B. LANGBEIN. *AEG-Mitteilungen*, Vol. 4, July 1931, pages 415–418.
A butt-welding machine is described. It is of a normal type but has been equipped with a clamping device for the pieces to be welded which is operated by compressed air to reduce the time for clamping and unclamping. This device is automatic; the air pressure remains during the whole welding process on the clamps so that the pieces are unable to move accidentally. Ha(11c)

Repair Welding on Steam Boilers. (Reparaturschweissungen an Dampfkesseln.) JOH. KRAFFT. *Schmelzschweissung*, Vol. 10, July 1931, pages 167–170.
First, the author discusses the rules and regulations for welding on boilers. This work must be entrusted only to reliable and responsible companies. The kind of boiler defects, corrosion, cracks or dents determines the manner of repair. Several examples and photographs illustrate repairs by welding. Ha(11c)

Welded Magirus Fire Ladder. (Geschweisste Magirus-Feuerwehrstahlleiter.) L. KUCHEL. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, July 18, 1931, pages 940–942.
A fire ladder of 38.4 m. total length in 5 parts is welded together from light steel profiles. The saving in weight, as compared with a wooden ladder, amounted to about 17% or 180 kg. The mechanical construction and test results are given. Ha(11c)

Physical Characteristics of Arc Welded Joints in Pipe Lines. J. F. LINCOLN. *American Gas Journal*, Vol. 134, Aug. 1931, pages 31–32.
The author discusses the reduction of construction and maintenance costs by use of modern welding methods in the fabrication of gas pipe lines. A major factor causing variations in tensile strength is the C content of the pipe metal. It should be kept down to 0.25–0.35% or 0.30–0.40%. The covered electrode arc process using "Fleetweld" gives very good welds. It prevents the formation of undesirable welds by eliminating oxides and nitrides which cause porosity, weaken and embrittle the weld. MAB(11c)

Welding Improves Design of Presses. J. F. LINCOLN. *Welding*, Vol. 1, Nov. 1930, pages 929–931.
The construction of frames of inclinable presses of welded parts provides a better distribution of metal, saving in weight and imparts a pleasing appearance. Ha(11c)

Arc Welding in Europe. E. DACRE LACY. *American Machinist*, Vol. 74, Mar. 19, 1931, pages 463–466; Mar. 26, 1931, pages 505–507.
Ship welding has been retarded by lack of skilled welders, opposition of trade unions, inability to purchase proper materials. Most of these are being removed now. Several welded ships have been built and have shown the value of welded construction. New and lighter steels have been introduced. "Ducol" steel 0.25% C, 1.5% Mn, tensile strength 40 tons compared with 30 tons for ordinary ship plate. Welded joints compared with 30 tons for ordinary ship plate. Welded joints of "Ducol" have tensile strength 40.4 tons/in.^{2}, fracture clear of weld, extension 17% in 8 in. Analysis of weld C, 0.215%; Si, 0.03%; Mn, 1.80%; S, 0.027%; P, 0.035%. Structural welding has been retarded by legislation but welded buildings have been erected in the last few years. Greater progress has been made in welding for railways. A welded carriage frame is in use on the Belgian State Railways, and welding is used extensively for repair work. RHP(11c)

The Measurement of Welded Seams. (Das Messen von Schweissnähten.) E. KALISCH. *Schmelzschweissung*, Vol. 10, July 1931, pages 181–183.
As all values of strength of welded seams are given in lbs./in.^{2} or kg./mm.^{2}, the exact measurement of the dimensions of the weld is of importance. A few special gages and methods of using them are described and illustrated. Their object is to obtain as correct a value as possible. Ha(11c)

Contribution to the Knowledge of the Temperature of the Oxy-Acetylene Flame and the Quality of the Weld in Their Dependence on the Water Vapor Contents in the Acetylene. (Beiträge zur Kenntnis der Temperatur der Azetylen-Sauerstoff-Flamme und der Güte der Schweissung in ihrer Abhängigkeit vom Wasserdampfgehalt im Azetylen.) H. JOOS. *Autogene Metallbearbeitung*, Vol. 24, Aug. 15, 1931, pages 241–252; Sept. 1, 1931, pages 259–267.
In an extremely exhaustive investigation, the temperature of the acetylene flame, the behavior of the oxy-acetylene flame and its temperature were determined for various contents of water vapor. The temperature of the flame was always assumed to be approximately 3000° C. The temperature is measured optically by means of the reversal of the spectral lines; it varied between 3250° and 2900° according to the amount of the water vapor (from 0 to 39.5%) and the height above the inner cone at which it was measured. The results were checked by 2 computing chemical methods. As a general result, it can be stated that water vapor up to about 7% as it occurs in acetylene has no harmful influence for practical welding either on the temperature of the flame or on the quality of the weld. Ha(11c)

Welded High-Pressure Tanks and Fittings; Applications of Experience in Steam Boiler Construction. (Geschweisste Hochdruckbehälter und Armaturen; Verwertung der Erfahrungen im Dampfkesselbau.) K. JURCZYK. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, June 27, 1931, pages 859–864.
This is a report on welding of tanks and fittings and of the difficulties experienced with it. Experience with boilers is of great help in making tests to find means for overcoming these difficulties. A great number of illustrations show the procedure in welding which may be most advantageously applied. Suggestions are made for guaranty tests. Ha(11c)

Increase of Output by Multiple Flame Welding Torches. (Leistungssteigerung durch Mehrflammenschweissbrenner.) E. KALISCH. *Die Schmelzschweissung*, Vol. 10, June 1931, pages 149–156.
An increase in the output of welds with simultaneous improvement of quality can be obtained by preheating the piece, by selecting a larger flame, by welding from both sides, by using right hand welding, or by the use of a multiple flame torch. The pipe welding machine with multiple flame torch increases production from 3 to 6 times. Different types of torch for different kinds of work are described and the saving of time as compared with the usual single flame torch is noted. A welding machine for welding of sheets from both sides is described. Ha(11c)

Switching and Welding Oscillograms of Rosenberg-Crossfield Dynamos with Regulating Poles. (Schalt- und Schweissoszillogramme von Rosenberg-Querfelddynamos mit Regelpolen.) F. KNILL. *Elektrotechnische Zeitschrift*, Vol. 52, July 9, 1931, pages 903–907.
The phenomena occurring during welding with metal electrodes, short-circuit and reduction of load of the welding machine are discussed. This discussion is based on oscillograms. The advantages of the Rosenberg-dynamo over other types of machines with regard to the damping of fluctuations are pointed out Ha(11c)

The Future of Welded Ship Construction. J. KJEKSTAD. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 13–16.
Paper presented before the fall meeting of the American Welding Society in Boston, Sept. 1931. Requirements of the design and method of construction of welded floating crafts are: maximum structural inherent and permanent efficiency; economy in designing, fabricating and erection; economy in operation and maintenance. The Truss Weld and the Reverse Channel systems of welded design are illustrated and explained. A welded hull will outsell, outwork and outlive any other type of hull. TEJ(11c)

The Relief of Welding Strains by Annealing. CHAS. H. JENNINGS. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 26–29.
Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Strains set up in welded specimens and residual stresses after annealing at 1000° F., 1100° F. and 1200° F. for various lengths of time, were measured by means of a strain gage. Welding strains and residual stresses can be reduced by annealing at a temperature below the critical. Reduction of welding strains depends on temperature and soaking time. Residual welding stresses can be reduced to a few thousand lbs./in.^{2} 4 references. TEJ(11c)

Use of the Oxy-Acetylene Flame in Making Storage Batteries. (Anwendung der Azetylen-Sauerstoff-Flamme im Akkumulatorenbau.) GUSTAV JONSCHER. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 189–190.
The hydro-oxygen flame which was formerly used for Welding lead is now almost entirely replaced by the oxy-acetylene flame because, with proper adjustment, it offers the same advantages and is cheaper, both in wages and fuel. Ha(11c)

Fabrication of Pipe Specials. OWEN C. JONES. *Journal American Welding Society*, Vol. 10, Aug. 1931, pages 13, 44.
Brief descriptions with illustrations of some special pipe connections fabricated by the oxy-acetylene process. TEJ(11c)

Future Development of Electrodes. T. E. JERABEK. *Welding*, Vol. 2, Sept. 1931, pages 623–625.
A review of the developments in arc welding electrodes during the past 5 years and a forecast for the future. Design of the electrode of to-day requires a knowledge of physical chemistry and metallurgy. Shielded arc electrodes will be further improved to produce welds having better physical properties. Higher welding speeds will be obtained and larger diameter electrodes, operating at higher currents and higher voltages, will be used. TEJ(11c)

Welding Applied to Compressed Air Machinery. H. W. KEEBLE. *Welder*, Vol. 2, Aug. 1931, pages 25–26.
Notes the possible economies for welded parts, especially for portable equipment. Ha(11c)

The Field of Resistance Welding. P. M. HALL. *Welding*, Vol. 2, Sept. 1931, pages 607–608, 610.
Advancements in the art of resistance welding during the past 5 years have been in the form of improved machines to fit the job, and more nearly foolproof methods of operation. The establishment of welding research laboratories; a change from the sliding patent design to a swinging grease-sealed bearing design; a method for removing the flash; and improved seam-welding machines, are forecast for the future. TEJ(11c)

The Metallurgy of Welding of Steel with Particular Consideration of Steam Boiler Construction. (Zur Metallurgie der Schweissung von Stahl, mit besonderer Berücksichtung des Dampfkesselbaus.) A. FREY. *Krupp'sche Monatshefte*, Vol. 12, Aug.-Sept. 1931, pages 201–214.
The first thing which must be considered in the manufacture of welded steam-boilers is the necessity of selecting material that is suitable, from the viewpoint of weldability, endurance strength, aging and corrosion resistance. The electric resistance welding process is, metallurgically, the most favorable pressure welding method for small sections. Water gas welding has been proved successful. The different fusion welding methods are not yet sufficiently developed. It is shown that even when alloyed electrodes are of a composition very different from that of the main material, they produce seams of high strength and toughness. This method promises to be of particular advantage in the future for boiler design. A standardization of testing methods, especially, of dynamic testing, is advocated. 18 bibliographical references are given. Ha(11c)

Welding Manganese Steel. JOHN HOWE HALL. *Electric Traction*, Vol. 27, Aug. 1931, pages 400–402.
Mn-steel as made and used for special track work and containing about 1.25% C and 11–14% Mn has always been a difficult material to weld successfully. On account of its high C content, Mn steel in its cast state contains a large amount of free carbide or cementite, which makes it weak and brittle until it is heat treated by quenching in water from a high temperature. This treatment makes the steel strong and tough, due to the complete solution of the carbide. The quenched steel very readily liberates its carbide again on reheating to comparatively low temperatures. The Taylor-Wharton Iron and Steel Company has recently developed and patented (U. S. Patent 1,732,202) a special type of Mn steel which has been christened Timang, which contains the usual proportion of Mn, a lower content of C, and about 3% Ni. This steel does not normally contain free carbide, and does not require quenching in water to render it tough, in fact, a plain normalizing treatment is all that is generally applied to it. When used as a welding rod for making welds in Mn steel castings, this special steel appears to affect the zone of the weld in two ways. In the first place, it dilutes the C of the Mn steel close to the weld so that there is less tendency to the liberation of carbide than when regular Mn steel is used as a welding rod, and in the second place, it causes the Mn steel close to the weld to absorb a certain amount of Ni. The low C and the Ni content of the weld zone so reduce the carbide separation and promote the air toughening property that welds made with this rod are tougher in the condition as welded than even reheat-treated welds made with Mn steel rod. WAT(11c)

Cause and Prevention of Heat Cracks in Aircraft Welding. H. S. GEORGE. *Welding*, Vol. 2, Aug. 1931, pages 524–529.
See *Metals & Alloys*, Vol. 2, Sept. 1931, page 178. TEJ(11c)

Welding-Technical Ramblings. (Schweisstechnische Streifzüge.) HANS A. HORN. *Die Schmelzschweissung*, Vol. 10, July 1931, pages 173–179.
A short report on hot-tearing tests made in the experimental and training shops at Berlin on autogenously and electrically welded rods is given. The tensile and elongation values are cited; the results are better for the gas welding method. Mistakes made in the preparation of boiler repair are also discussed and illustrated by photomicrographs. Several good ways are recommended. Ha(11c)

Welding of Copper-Nickel Alloys. (Die Schweissung von Kupfer-Nickel-Legierungen.) HANS A. HORN. *Apparatebau*, Vol. 43, May 15, 1931, pages 112–115.
See *Metals & Alloys*, Vol. 2, Sept. 1931, page 181. (11c)

Critical Review of Welded Pressure Tanks. (Kritische Betrachtung von Druckgefässen in geschweisster Ausführung.) H. HAENDLY. *Schmelzschweissung*, Vol. 10, July 1931, page 171.
Using a pressure tank for 15 atmospheres at 300° C. and 500 mm. inner diameter as example, the calculation is explained with the view of obtaining the lowest factory cost. Ha(11c)

Experiments on the Weldability of Silicon Steel. (Versuche zur Ermittlung der Schweissbarkeit des Siliziumstahls.) H. GRAHL. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 593–599.

Report 173 of the Committee on Materials of the Verein deutscher Eisenhüttenleute. Welding tests under pressure were carried on on structural steels containing up to 1.35% Si. Up to this content, no unfavorable effect on the weldability was observed. The increase of tensile strength through Si is lost in welding due to the oxidation which is favored by the element. The most suitable welding temperature of silicon structural steels is 1435° C. Welded joints had a tensile strength of about 97% of the silicon steel itself. The notch toughness of those joints shows the same characteristic temperature dependence as the non-welded material, the critical temperature range, however, i. e., the transition from high to low values of notch toughness, is shifted to higher temperatures. Best results in welding silicon steels under pressure will be obtained when the joints are heated to temperature as rapidly as possible and the presence of O is avoided as much as possible. GN(11c)

Tests on Weld Metal. P. T. HOLLIGAN. *Welder*, Vol. 3, Sept. 1931, pages 8–20.

A series of tests with 3 types of electrodes ("Cresta," "Medex" and "Ducol") have recently been carried out by the Welding Research Department of the Synthetic Ammonia & Nitrates, Ltd., in England. From them, the following conclusions can be drawn: Medex and Cresta deposit metal which gives a strength comparable to that of ordinary mild steel. Their ductility is about $^2/_3$ that of the best mild steel. The Ducol electrode deposits metal of much higher tensile strength than either Medex or Cresta, but the ductility is slightly less. Under bend tests, Medex metal gave the best results; Cresta was slightly inferior; Ducol was inferior to both the others. Ducol deposits an alloy steel weld containing Mn and Ni. The effects of heating and cooling are therefore, greater on this metal than on ordinary C steel. Most remarkable was the low C content shown in the analyses of the deposited metal which is responsible for the high tensile strengths. An analysis showed in all cases a Ni content of 0.06%. The fatigue tests gave almost as good results as solid homogeneous mild steel. All tests are described in detail and illustrated in micrographs and tables. Ha(11c)

Direct Current, Single Phase or Three Phase Arc Welding? (Gleichstrom-, Einphasenstrom- oder Drehstrom-Lichtbogenschweissung?) J. C. FRITZ. *Elektrotechnische Zeitschrift*, Vol. 52, July 16, 1931, pages 932–934.

The advantages and disadvantages of the 3 methods are weighed against one another. Each of the 3 processes has a special field; but, in general, it is true that in Germany the single-phase arc has gained a foremost position. In this method, as with direct current, an electrode with coating is used preferably. Three-phase welding is seldom used. The constructions and performance of d. c. generators and welding transformers are discussed and some special equipment is described. Automatic welding has been restricted largely to d. c. welding. 6 references. Ha(11c)

Welding of Structural Steel. J. E. FERGUSON. *Journal American Welding Society*, Vol. 10, July 1931, pages 39–43.

Strength of welded joints is comparable to strength of riveted joints. Design of welded members is entirely different from design of riveted members. Illustrations of welded joints are shown and shop and field welding described. The author cites advantages of arc welding over riveting in structural steel fabrication and erection. The proper fabrication of welded steel includes: (1) The use of correct sections. (2) Logical designs for this particular use. (3) Suitable details for welding. (4) Right kind of plant layout. (5) Right equipment, particularly welding machines, grids, jigs and handling equipment. (6) Proper kind of organization, suitable training of welders. (7) Proper inspection. TEJ(11c)

Welding of Cast Iron Pipe. T. W. GREENE. *Journal American Welding Society*, Vol. 10, July 1931, pages 30–33.

Paper presented at joint meeting of American Welding Society, American Society of Civil Engineers, American Water Works Association on June 9, 1931. Laboratory and field tests show advantages of bronze welded cast iron pipe over other methods of joining. Strength of joint, resistance to corrosion and cost are considered. Welding rod used is of the 60% Cu and 40% Zn type. TEJ(11c)

Electric Welding. Annual Report of the Committee on Electric Welding. P. P. ALEXANDER, *et al.* *Electrical Engineering*, Vol. 50, Section II, July, 1931, pages 557–560.

The report consists of two sections—the first dealing with organization and policies, and the second with the progress of the art. Resistance welding, structural steel welding, shipbuilding, automatic machines, alloy electrodes and special arc torches are discussed, and the design of electric arc welding generators, testing of welds and fourteen suggestions given for further research on the phenomenon of the electric arc. WHB(11c)

Welding of Tubes in the Construction of Airplanes. (Ueber die Schweissung von Rohren im Flugzeugbau.) A. KOPPENHOEFFER. *Autogene Metallbearbeitung*, Vol. 23, May 1, 1930, pages 134–137.

The experiences of the Heinkel Flugzeugwerke A.-G. show that acetylene welding of tubes for airplane construction offer great advantages over all other welding methods. Among the advantages noted are flexibility of kind of joints, great liberty in shaping the members, speed of manufacture and, with experienced personnel, neatness of work. Three kinds of material which may be used depending on the purpose are discussed in detail. It is important, in producing a perfect weld, that the sections which are welded together be not too different, since cracks may easily occur near the seam. It goes without question that only most experienced welders are to be entrusted with such responsible work. Ha(11c)

The New Welding Laboratory of the Technical University Karlsruhe. (Das neue Schweisslaboratorium der Technischen Hochschule Karlsruhe.) A. KESSNER. *Die Schmelzschweissung*, Vol. 9, May 1930, page 112.

The first course was taken by 120 students. Importance of the proper training is pointed out. Ha(11c)

Welding with the Oxy-illuminating Gas Process. H. H. LURIE (Purdue University.) *Bulletin, Utilities Research Commission*, Vol. 2, May 1931, pages 1–4.

Welding with city gas at the usual low pressure is impractical. By use of a booster to give higher pressures, special Mekker type tips, with injection of oxygen by means of high pressure gas, and a mantle of unmixed city gas outside the flame, welds of 80% efficiency were made in light gages of steel, up to $^1/_4''$ thick. Cast iron can be welded in much heavier cross sections, up to $1^1/_2'' \times 2''$ or more. By the line reversal method, the maximum flame temperature was determined as around 2600° C., against around 3100° C. for oxy-acetylene. Mixed city and natural gas in an 800 B. t. u. mixture, which will be available in many localities, should extend the range of welding with gas. HWG(11c)

Riveting (11d)

Riveting Methods in the Construction of Metal Airplanes. (Nietverfahren im Metall-Flugzeugbau.) W. PLEINES. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.–June 1931, pages 166–173.

A report of the Deutsche Versuchsanstalt für Luftfahrt. See *Metals & Alloys*, Vol. 2, May 1931, page 104. Ha(11d)

Sil-Fos

Brazing Alloy Patent Granted

The remarkable brazing qualities of this new alloy have been recognized by the granting of Patent No. 1,829,903.

SIL-FOS

1. Melts at 1300° F. (300 to 800° less than common brazing and welding rods).
2. Is free flowing—penetrates deeply and quickly and makes neat joints.
3. Makes strong, sound, ductile joints (tests show 30,000 to 35,000 lbs. per sq. in. on copper lap joints).
4. Joins copper, brass, bronze, extruded brass and bronze, nickel, monel and other non-ferrous metals.
5. Works fast—saves time.
6. Requires less than the usual amount of flux —none at all in some cases.
7. Joints are easy to clean.
8. Resists corrosion.
9. Contains silver.
10. Sold by the *pound* in standard strip, rods and pulverized, at surprisingly low prices for a silver alloy. In addition to its many advantages in working qualities, Sil-Fos is *economical* to use.

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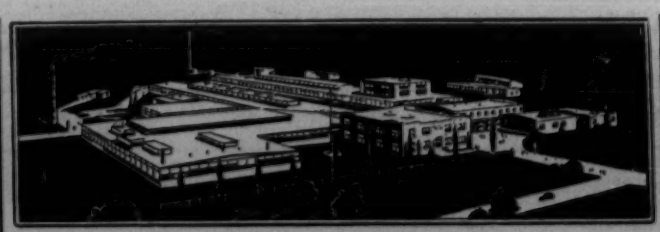

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

The Application of Temperature Measuring Instruments and Waste Gas Testers in the Open Hearth Furnaces. (Ueber die Anwendung von Temperatur-Messgeräten und Abgasprüfern an Siemens-Martin-Oefen.) W. LIESEGANG & W. WINKHAUS. *Archiv für Eisenhüttenwesen*, Vol. 4, Mar. 1931, pages 421–429; *Stahl und Eisen*, Vol. 51, Apr. 16, 1931, pages 497–498.

Report No. 148 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. Temperature measuring instruments to control the open-hearth furnace are suitably installed in the checkers above the brick lining. Radiation pyrometers proved superior to thermocouples. Special installation devices, however, are necessary to guarantee proper readings. Otherwise, soot and water are deposited on the lens of the pyrometer, thus causing wrong readings. In order to avoid this, the pyrometer (Ardometer) is placed upon a water-cooled jacket and air is blown in front of the lens when readings are to be taken. The correctness of the readings depends upon the supposition that the radiating and sighted body is a black body. This holds true for the radiation of the checker investigated. The temperature distribution of the gas checker was studied and the difference was determined between the wall temperature and the gas temperature. The temperatures were compared with the readings of a flow pyrometer. It is shown that the temperature taken with the radiation pyrometer is approximately the temperature of the sighted wall but not the temperature of the gas. The second part of the paper refers to the taking of gas samples which should be done in the ports. A new type of gas taking device, provided with ceramic filter is described and has been successfully tested. The recorders of all controlling instruments are centrally installed on the furnace platform. GN(12a)

Zirconium Alloys in Steel Manufacture. PH. GUY. *Iron Age*, Vol. 127, June 11, 1931, page 1895.

Abstract translation of article in *Aciers Speciaux, Métaux et Alliages*, Nov. 1930. Discusses the use of Zr alloys for deoxidation and purification in steel making and the effect on the physical properties. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 147. VSP(12a)

Physical Chemistry of Basic Open Hearth Reactions during Melting. (Contribution a l'étude physico-chimique des réactions du four Martin basique pendant la période de fusion.) J. GERMEAU. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 151–156.

Brief discussion of the thermodynamics involved. HWG(12a)

The Manufacture of Cast Iron in the Electric Furnace. WALTER LISTER. *Foundry Trade Journal*, Vol. 43, Sept. 4, 1930, pages 165, 167.

According to author's experiences, Fe for molds over 3 tons capacity and up to 60 tons is made in basic electric furnaces. The electric Fe gives much better results than ordinary cupola Fe. Greater control can be exercised over analysis and melting conditions. Best method is to use 50% pig Fe and 50% steel scrap in the charge. For 10-ton charge about 4 cwts. of coal and 4 cwts. of lime should be added to make the slag. The operation takes about 4 hrs. and current consumption is about 450 kw.hrs./ton. The duplex method is used for the manufacture of high class castings. The process consists in transferring molten Fe from the cupola to the electric furnace and there superheating and refining it, and adjusting the analysis to desired specification. Includes tables giving comparative tests of cupola melted Fe before and after treatment in electric furnace, and also comparative costs. VSP(12a)

High Frequency Induction Melting for Quality Steels. (Remarques sur du four a induction a haute fréquence pour la fabrication des aciers l'emploifins.) M. LACROIX. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 217–225. 5 figures. 16 references; *Revue de Métallurgie*, Vol. 28, Mar. 1931, pages 151–161.

Describes installation and operation of the furnaces on a variety of steels. The oxidizing atmosphere is an inconvenience but the surface can be protected. HWG+JDG(12a)

Progress in Construction and Operation of the Coreless Induction Furnace for Making Steel. (Fortschritte in Bau und Betrieb des kernlosen Induktionsofens zur Stahlerzeugung.) N. BROGLIO. *Stahl und Eisen*, Vol. 51, May 14, 1931, pages 605–613; May 21, 1931, pages 635–644.

Report No. 208 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The report covers further results of the induction furnace of the Rüderoth Steel Works. (First report, *Stahl und Eisen*, Vol. 50, 1930, pages 617–629.) The life of the furnace crucible could be increased to such an extent that the furnace could be run continuously during a whole week without making repairs. Consumption of current and time are discussed on the basis of the energy balances established. The results are compared with the crucible process, the open hearth furnace and the electric arc furnace. This was done to illustrate the efficiency of the induction furnace. An essential advantage of the induction furnace is that very high temperatures can be reached. Although there is a possibility of producing unclean steels, a careful control of the furnace guarantees the production of high quality steels. An absolute absence of slag inclusions in the steel can also be achieved. The temperatures of the furnace can be controlled without difficulties. GN(12a)

Open-Hearth Furnace Control. MARTIN J. CONWAY. *Iron Age*, Vol. 128, July 23, 1931, pages 244–245, 278.

Includes discussion. Abstracted from a paper read at Cleveland, June 17, before the Combustion group of the Association of Iron & Steel Electrical Engineers. Discusses application of the control and gives results of calculations, showing pressures necessary in overcoming resistance to gas flow through the system. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 189. VSP(12a)

Modern Design and Operation of Open Hearth Furnaces. (Ueber neuzeitlichen Bau und Betrieb von Siemens-Martin-Oefen.) E. DIEPSCHLAG. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 8, 1931, pages 1005–1012.

The growing importance of the open hearth process is discussed and explained by economic necessity because the increased supply of scrap can be converted most economically in the open hearth process. The fuels for heating these furnaces are compared. On the basis of 1,200,000 kcal./ton, the required amount of fuel for 1 ton of steel is oil, 124.16 liters; tar, 104.57 liters; coal, 238.1 kg.; coke oven gas 306.12 m.³ The different kinds of mixed gases are discussed and the consumption/ton of steel is compared for different preheating of air. Constructive details of burners, hearth and tilting arrangements are illustrated. For the relation between size of furnace and economy, curves are developed, taken from furnaces in operation in all industrial countries. Fuel consumption decreases with capacity. Large open hearth furnaces should be built as tilting furnaces so the slag can be handled easily. 32 references. Ha(12a)

Melting of Gray and Malleable Iron in the Indirect-Arc Furnace. J. C. BENNETT & J. H. VOGEL. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Aug. 1931, pages 235–256.

The data on Fe qualities are discussed and the costs of operating indirect-arc melting furnaces are outlined. See *Metals & Alloys*, Vol. 2, July 1931, page 135. CHL(12a)

Causes of the Action of Thomas Slag. (Ursachen der Wirkung des Thomasmehls.) TH. DUNKEL. *Stahl und Eisen*, Vol. 51, June 25, 1931, pages 794–796.

The author reviews a paper by A. Wilhelmj in *Zeitschrift für Pflanzenerneuerung, Düngung und Bodenkultur*, A. 19, 1931, pages 129–239 on this subject. A very large number of Thomas slags of various origins were tested to determine their fertilizing value. All tests indicate that all Thomas slags with a higher content of "soluble" silica are superior to those with lower content of "soluble" silica. Wilhelmj points out that the steelmaker should process his Thomas slag with a higher percentage of silica. GN(12a)

Slag Reactions in the Basic Open Hearth. (Beiträge zur klärung der Schlackenfrage in Basischen Siemens-Martin-Ofen.) R. BACK. *Stahl und Eisen*, Vol. 51, Mar. 13, 1931, pages 317–324; Mar. 19, 1931, pages 351–360.

Report No. 204 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Including discussion. The investigations were carried on on 19 basic open hearth melts and the reactions during the melting and the boil were studied. The basicity as the variable of the relation $CaO:SiO_2$ was determined. It was found that even during the melting, the Fe loss increases with basicity, an occurrence which has its cause in the opposite behavior of SiO_2 and FeO and Fe_2O_3 in the slag. As to the loss of Mn, no simple relation similar to that found for the loss of Fe could be established. During the boil, both elements are lost increasingly with the basicity of the slag. The reactions, in particular those of Fe and Mn, were studied during the progress of the melt, from the beginning melting to the finishing of the heat under the presence of 5 various types of slags: a slag with high acid content, medium and normal acid content, a normal basic slag and a slag with a high content of bases. The acid slags unexpectedly gave favorable results as to the balance of the Mn. In the slags with medium basicity, the largest amount of Mn re-enters into the bath. With the basic and high basic slags, the reduction of Mn ceases. However, in these slags, the re-entering of Mn from the slag into the bath is favored by higher furnace temperatures. Similar conditions as to the reactions of Fe prevail during the boil. The above stated reactions of Mn must be explained by the behavior of Fe, inasmuch as the FeO content of the slag increases with the basicity and oxidizes Mn. The prevailing effect of the slags upon the reaction of Fe and Mn makes it advisable to study the composition of the slag more in detail during the making of the heat. 12 types of slags of various basicity are shown in pictures. GN(12a)

Casting & Solidification (12b)

Influence of Temperature and Cooling Conditions in Casting of Zinc. (Einfluss der Temperatur und der Abkühlungsverhältnisse beim Zink Giessen.) O. BAUER & P. ZUNKER. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 3–26.

Of the very exhaustive tests to elucidate the influences of temperature of pouring, temperature of ingot mold, wall thickness of the mold on the formation of pipes and nature of structure, the following principal results will be mentioned; for details, the paper with its many illustrations and tables must be referred to. When using a metal ingot mold with thick walls, the cast ingot showed at 420° C. (the lowest pouring temperature) the greatest pipe; with increasing temperature, the hollow space decreased and, from an average pouring temperature, it started to increase again. When using a stone mold, the pipes are greater than in ingots cast in metal molds. The structure shows long crystals while in metal ingots the structure shows fine crystals. Preheating of the mold results in greater pipes than an increase in pouring temperature; the size of the pipe increases almost linearly with increasing mold temperature; the pipes are deeper. The crystal structure is considerably coarser. The same results were obtained with a stone mold of great wall thickness but, due to the much more delayed cooling, the solidification by the air on top of the ingot is of greater importance and the formation of pipes in the interior is enhanced. The structure becomes coarser with increasing mold temperature. When such ingots were machined, cracks and splitting was a frequent occurrence. The tests were repeated with molds of only ½–2 mm. wall thickness. In general, the pipes were smaller than with thick walls; for 2 mm., they were smaller than for ½ mm. The structure is fine at 420° C., but soon becomes coarse at higher temperatures. Molds of thin wall thickness have the disadvantage that due to their great heating after pouring they warp easily and the ingot has a bad shape. The cooling requires much more time. If a mold with thin walls is water-cooled immediately after pouring, ingots with small pipes could be obtained; increased temperature also resulted here in bigger pipes. The crystal structure consists mostly of long needles. For different pouring velocities, the ingot cast most quickly had the biggest pipe; a decrease of pouring velocity also reduced the size of the pipe. On the other hand, the greater the pouring velocity, the finer the grain in the ingot; the finer the grain, the better the mechanical properties. Molds of thin walls seem to give, under special pouring conditions, fine grain with an unimportant-formation of pipes. Ha(12b)

Continuous Ingoting of Molten Metal. (Contribution a l'étude du l'ingotage continu des métaux en fusion. Procédé Douteur-Chantraine.) J. CHANTRAINE. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 95–102.

Proposal, with sketches from a patent, to avoid ingot molds and blooming mills by continuous casting of molten metal into a long bar of relatively small cross section, past moving chills. It was brought out in discussion that no apparatus had been constructed to test the idea though specific claims for saving 100 francs per ton were put forth. HWG(12b)

Unsoundness in Aluminium Sand-Castings. Part I. Pinholes: Their Causes and Prevention. Part II. The Effects of Using Metal Previously Subjected to Corrosive Conditions. D. HANSON & I. G. SLATER. *Institute of Metals, Advance Copy* No. 569, Sept. 1931, 29 pages; *Advance Copy* No. 570, Sept. 1931, 12 pages.

Part I. The presence of pinholes is probably caused by H absorbed in the molten alloy. The H probably results from the decomposition of water vapor by the molten Al. Pinholing was studied by casting in a tapered mold, sectioning the resulting casting and examining for unsoundness. Bubbling steam through molten Al and several Al alloys increased the unsoundness. Bubbling dry N through the alloys improved the soundness, but the effects of commercial gas, containing water, were deleterious. Cl in some cases improved soundness. A mixture of dry N and Cl was quite effective in laboratory experiments and in 60 lb. commercial melts. In 200–300 lb. melts, however, the treatment was not effective because it was necessary to heat the alloys to too high a temperature in order to permit the pouring of the entire melt. Treatment with $TiCl_4$ improved some alloys, but much fume was liberated when using this liquid. Additions of S, Se and Te in quantities up to 1% were studied. S increased the porosity. Se and Te in some alloys effected a slight improvement, but adversely affected the physical properties. Heating an alloy containing Zn to 950° C. and cooling to 750° C. before casting increased the soundness. A similar treatment of alloys containing up to 1% Cd did not produce a similar improvement. Contains 13 references.

Part II. Virgin Al and Al alloys that had been exposed to corrosive conditions were sand cast and examined for soundness. It was found that the unsoundness increased as the severity of corrosion increased. Storage in a dry room prior to casting produced but little unsoundness. Pickling and electrolytic treatment prior to melting also increased the unsoundness, but not as greatly as outdoor corrosion. It is suggested that the unsoundness results from the absorption of nascent H formed during corrosion. JLG(12b)

Practical Method to Avoid Pipes in Die Casting of Certain Pieces. (Procédé pratique p ur éviter les retassures dans la coulée en presse de certaines piéces.) J. CHARTIER. *Revue de Fonderie Moderne*, Vol. 25, July 10, 1931, page 241.

By arranging the single pieces in the mold vertically one above the other and casting from the bottom so that the metal rises from the lowest to the highest, no pipes will be formed if the metal is soft and has at least 3.3–3.5% Si. Ha(12b)

Contributions to the Question of Primary Crystallization. I, II. (Beiträge zur Frage der Primärkristallisation. I, II.) W. CLAUS & R. HENSEL. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 15, 1931, pages 399–408; May 29, 1931, pages 437–442; June 5, 1931, pages 459–464; June 12, 1931, pages 476–482; June 19, 1931, pages 499–502.

It has been recognized that besides the determination of the microstructure of a casting, the macrostructure is also of importance. The structure of a steel block cast in an ingot mold consists of a marginal zone of small crystallites, a transcrystallization zone of columnar crystals and a core or equiaxed range. The mechanical properties of the marginal zone and the core are considerably better than those of the transcrystallization zone which, for this reason, is an undesirable condition. The authors set out to determine the orientation of the primary crystallites for which 5 methods are discussed and described. The following conclusions were drawn: the marginal zone of a steel ingot is irregular. The transcrystallization zone is directed with one axis vertical to the cooling surface and columnar crystals are formed. The core is irregular. A crystallographic relation between core and transcrystallization zone could not be discovered but between transcrystallization and marginal zone a connection exists as the former grows out of the last layer of the irregular crystals. The second part deals with attempts to find the laws for the formation of the peculiar structure in steel ingots treated in part one. Of the very exhaustive discussions and descriptions of testing methods, the following review can be given in brief: It could be stated that under-cooling does not occur in cast metals; this cannot, therefore, originate the primary structure. Between 2 points of a melt in a metal mold, no temperature difference (except in the first moment) occurs The temperature of the cast melt after pouring drops immediately to the melting temperature and remains constant until solidification. To explain the crystallization by thermal reasons, it was assumed that an irregular structure is due either to a too fast heat conduction (effect of the mold) or to a too slow heat conduction (heat accumulation). From numerous experiments to determine the character of the structure as dependent on pouring temperature and mold conditions, it could be stated quite generally that all structural changes can well be explained by thermal conditions. 45 references supplement the paper. Ha(12b)

Large Steel Ingots for Forging. HERBERT H. ASHDOWN. *Iron Age*, Vol. 127, June 1931, pages 1888–1890.

Based on paper read at the Chicago meeting of the American Society for Steel Treating. Includes discussion. Rotating molds for forging ingots during casting accelerates solidification, thereby arresting segregation and insuring uniform analysis. See "Steel Ingots," *Metals & Alloys*, Vol. 2, July 1931, page 135. VSP(12b)

Prevent Losses with Proper Gates and Risers. PAT DWYER. *Foundry*, Vol. 59, Jan. 1, 1931, pages 56–60; Aug. 15, 1931, pages 35–37, 41.

Lack of practical knowledge on such points as gating, risers, shrink heads and suitable pressure for light or heavy castings is still a cause of a great number of defective castings. In some instances the size, shape and position of the gate are of major importance. Clean castings are secured by pouring the Fe through a multiplicity of small pop gates on the top. Experienced molder should devise the most suitable method of gating and heading each casting. Pressure is important factor in securing solid castings. Porous and spongy castings are caused by too many risers and shrink heads. The fifteenth of the series deals with the various types of gates and risers used in the foundry industry. A feature of roll pouring methods might be adopted in the production of many other castings. The pouring basin is set at a height that will insure its complete evacuation by the time the metal has risen to the top of the mold. The only scrap iron produced is the metal remaining in sprue, gate and sink head. On large castings, it is customary to introduce the first metal at the bottom of the mold, then pouring remainder down through pop gates at the top. VSP(12b)

Cast Aluminum Bronzes. III. Shrinkage Phenomena. IV. Theory of Shrinking. V. Mechanical-Technological Properties. (Gegossene Aluminiumbronzen. III. Schwindungserscheinungen. IV. Theorie der Schwindung. V. Mechanisch-technologische Eigenschaften.) W. CLAUS & F. GOEDERITZ. *Die Giesserei mit Giesserei-Zeitung*, Vol. 17, Oct. 17, 1930, pages 1017–1023; Vol. 18, Apr. 17, 1931, pages 319–326; Apr. 24, 1931, pages 340–346.

In studying the macrostructure of cast Al bronzes, castings of 4.5, 7 and 10% Al, and a Si-Al bronze are made in dry and moist sand and in chill molds, pouring at 1250°. Shrinkage pipe is present in the core of the 7 and 10% Al bronzes when cast in either the dry or the moist molds. The 4.5% Al bronze shows small defects in the bottom of the casting, but no shrinkage pipe in the head. This bronze when cast in a chill mold gives a dense casting. Shrinkage pipe is shown by the 4.5, 7 and 10% bronzes when cast in chill molds. The Si-Al bronze shows slag defects in the foot when cast in the sand molds and a central porosity when cast in the chill mold. Lower pouring temperatures (1050°) do not affect the shrinkage pipe in the 10% Al bronze when cast in the dry sand mold. The comparative discussion of shrinking of Al and Sn bronzes shows that the linear shrinkage measures do not give a critical value. The values of cubical shrinking and the reduction to linear shrinking do not give a correct measure, either. The extraordinary difference between the 2 kinds of bronzes seems to point to an absolutely different distribution of the same total shrinkage to the liquid and solid phase, respectively. Macro-formation of pipes can take place at unfavorable solidification velocity. In all binary Al bronzes, intercrystalline micro-formation of pipes takes place besides the macroformation. Dry casting of binary Al bronzes in vertical molds has throughout given poor qualities of mechanical strength which, under certain conditions, may be improved by casting in horizontal dry molds. Metal mold casts always produced a technically excellent material. Binary Al bronzes cannot be cast in sand. The test results for tensile and bending and hardness, etc. are tabulated; 25 references and a list of publications are cited. Ha(12b)

On the Formation of Graphite in Cast Iron. (Ueber die Graphitbildung im Gusseisen.) H. HANEMANN. *Stahl und Eisen*, Vol. 51, July 30, 1931, pages 966–967.

It is shown by microscopic examinations of water-quenched cast iron specimens (C, 4.15%; Si, 0.09%; Mn, 0.18%) that the graphite is formed even during the solidification directly in the melt and not by disintegration of cementite. GN(12b)

Rolling (12c)

Theoretical and Practical Power Consumption during Rolling. (Theoretischer und praktischer Arbeitsbedarf beim Walzen.) A. GELEGI. *Stahl und Eisen*, Vol. 51, July 9, 1931, pages 886–887.

Abstract of a paper presented before the Hungarian Society of Engineers and Architects, Feb. 15, 1930. A simple formula has been developed to calculate the power consumption in rolling common shapes. GN(12c)

Determination of the Neutral Line of a Pass. (Beitrag zur Bestimmung der neutralen Linie eines Kalibers.) W. DAHL. *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 633–635.

Report No. 85 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. A new method for determining the line of rolling mill passes is described. It is shown by examples that the new method gives the same results as Tafel's method, but it is simpler and can also be used for intricate shapes where Tafel's method fails. GN(12c)

Chilled Cast-Iron Rolls, Their Failure and Its Causes. (Hartgusswalzen, ihre Fehler und deren Ursachen.) W. BREITENBACH. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 6, 1931, pages 206–209.

It is contented that most failures of rolls which are ascribed to defective materials are, in reality, due to faulty treatment in the rolling mill. A few failures which occur more frequently such as breaking of pinions, cracks in the roll surface, etc., are discussed. Their causes are explained and suggestions are made for coöperation with the foundry. Ha(12c)

Sheet and Tinplate Rolls. An Investigation into the Roll Loads, Stresses and the Causes of Roll Breakage. J. SELWYN CASWELL. *Proceedings South Wales Institution of Engineers*, Vol. 46, Aug. 22, 1930, pages 311–452; *Sheet Metal Industries*, Vo. 4, Oct. 1930, pages 429–434; Nov. 1930, pages 523–531.

After discussing the manufacture of sheet and Sn-plate rolls, the author presents data gathered over a year's time in 29 sheet and 28 Sn-plate mills. On roll breakage, temperature variations in the mills, loads carried by sheet and Sn-plate rolls, torsional loads, physical properties of gray and chilled roll Fe, the magnitude and variation of the stresses in the rolls set up (1) in the foundry, (2) by the mill loads, (3) by thermal strains and (4) by other causes and hair-cracks and firemarks on the faces of fracture. The ratio of number of rolls broken annually to number of mills is approximately 1.8 for Sn-plate and 4.0 for sheet mills. Average life of rolls is 16 weeks and 8 weeks for Sn-plate and sheet mill rolls, respectively. In Sn-plate mills, life depends chiefly on the life of the chill; in sheet mills, on breakage. Greatest breakage is in winter. 82% broke through the body. Breakage is more frequent with large diameter rolls. Maximum loads in Sn-plate roughing mill = 500 tons; in finishing mill = 420 tons; in sheet mill = 1140 tons. Maximum torque is approximately 17,000 in.-ton. WHB+AWM(12c)

Rolling Alloys of Copper and Phosphorus. OWEN W. ELLIS. *Iron Age*, Vol. 127, June 4, 1931, page 1818; *Engineering*, Vol. 131, Mar. 13, 1931, page 376; abstracted in *Engineer*, Vol. 151, Apr. 3, 1931, page 374.

Abstract of a paper read before the Institute of Metals, Mar. 1931. Discusses results of rolling experiments on alloys of Cu with 2–6% P, with and without the addition of 5, 10 or 15% Mn or Ni. Discussed in *Engineering*, Vol. 131, Mar. 27, 1931, page 411. See *Metals & Alloys*, Vol. 2, July 1931, page 135. LFM(12c)

Continuous Billet and Bar Mill of the Trinec Mining and Steel Company. (Kontinuierliches Knüppel- und Platinenwalzwerk der Berg- und Hüttenwerksgesellschaft, Eisenwerk Trinec.) W. BRUNS. *Stahl und Eisen*, Vol. 51, Apr. 30, 1931, pages 547–554.

The article gives a detailed and illustrated description of a continuous billet and bar mill built by the Demag Company at the above steel mill in 1930. The new mills are distinguished by the variety of the rolling program and the possibility of easily and rapidly changing the schedule. The article gives information on rolling schedule, operation, capacity and the crew of the mills. GN(12c)

New Separation Machine for Sheets. (Neue Aufreissmaschine für Feinbleche.) F. CHRIST. *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 648–649.

Since the sticking together of rolled double sheets causes loss of time and since the separating of these sheets is done only by hand at present, the Demag Company, Duisburg, has built a special machine for this purpose. An illustrated description of the new machine is given. GN(12c)

High Production Cooling Beds. (Hochleistungs-Kühlbetten.) E. KÄSTEL. *Stahl und Eisen*, Vol. 51, June 18, 1931, pages 764–767.

The article gives an illustrated description of new constructions of high production cooling beds by Krupp. The constructions are described in detail. GN(12c)

Machining (12g)

Latest Developments of Faster Milling. FRANK W. CURTIS. *Western Machinery World*, Vol. 22, June 1931, pages 242–244; July 1931, pages 291–294; Aug. 1931, pages 342–343.

The first of a series of articles regarding the use and application of tungsten and tantalum carbide cutters. Milling with carbide has not kept abreast with its application to other forms of metal cutting operations, largely because early experiments failed to show comparable results. The cost involved was not justified because no guarantee of performance was offered. It has only been within the past few months that manufacturers have come to realize the importance attached to the application of tungsten carbide to milling cutters. The article is more or less introductory. The design of a milling cutter as applied to the application of tungsten carbide is presented. In the second of a series of articles on this subject, a chart is given showing horsepower against table feed in inches per minute, for 5 inch diameter face milling cutters on cast iron, with 0.125 in. depth of cut and $4^1/_4$ inches width of cut. Curves are given for high speed steel at 76 ft./min., stellite at 130 ft./min., tungsten carbide at 250, 300 and 375 ft./min., the horsepower required increases in that order. A diagram is given showing a typical cutter designed for the machining of soft or medium cast iron. The third of this series of articles dealing with the use and application of tungsten and tantalum carbide milling cutters describes and illustrates the set-up used in milling of complicated cast iron shapes. WAT(12g)

Milling with Tungsten and Tantalum Carbide Cutters. FRANK W. CURTIS. *American Machinist*, Vol. 74, Jan. 29, 1931, pages 211–213; *Carboloy*, Vol. 4, May-July 1931, pages 5–15; *S. A. E. Journal*, Vol. 29, Sept. 1931, pages 232–235.

Application of tungsten carbide to milling is said to have lagged because results did not seem to justify the cost until modified cutter design was developed. Cutter angles that have proved satisfactory are given, and designs of cutters are shown. Rigidity in cutter, machine and fixture is emphasized as an important requirement and numerous examples of speeds and feeds are cited. Successful use of tantalum carbide for milling steel is reported and the paper concludes with a list of suggestions for the successful introduction of milling with these 2 cutting materials. Ha+RHP(12g)

Drawing & Stamping (12h)

Fabrication of Aircraft Stampings. T. WATSON DOWNES. *Metal Stampings*, Vol. 3, Aug. 1930, pages 731–732.

Abstract of paper read before the American Society for Testing Materials. See "Metal Joints in Aircraft Construction," *Metals & Alloys*, Vol. 1, Nov. 1930, page 850. MS(12h)

Standard Die Parts. ELLSWORTH E. CLARK. *Metal Stampings*, Vol. 3. Nov. 1930, pages 991–994; Dec. 1930, pages 1095–1098.

Discusses developments in standardization of die parts and advantages thereof. Gives practical illustrations of the application of standard parts and methods in the construction of metal-stamping dies. MS(12h)

Standard Brake Dies of Simple Design. GLENN A. BARTH. *Metal Stampings*, Vol. 3, Nov. 1930, pages 1007–1008.

Deals with development of ridge-roll and corrugation-forming dies for press brakes. MS(12h)

Applications of Sealing Metal in Die Construction. ELLSWORTH E. CLARK (Westinghouse Elec. & Mfg. Co.). *Metal Stampings*, Vol. 4, Mar. 1931, pages 225–228.

The specifications and requirements for a suitable sealing metal alloy are defined. The design of a complicated compound die and its construction with the aid of sealing metal is described in detail. The advantages of this method of die construction and some of the precautions to be observed in its utilization are cited. JN(12h)

The Application of Welding to Die Construction. ELLSWORTH E. CLARK (Westinghouse Elec. & Mfg. Co.). *Metal Stampings*, Vol. 4, Feb. 1931, pages 113–117.

Gives new method developed by the author for fabricating dies by the arc welding process. As an illustration, he describes the complete manufacture of a die set from machine steel plates for forming a shallow drawn shell. Also gives examples of correct and incorrect designs of various welded joints. Claims cost reductions in both labor and materials and urges that die builders look into this method. JN(12h)

Aluminum Sheet for Stamping and Drawing. R. J. ANDERSON. *Metal Stampings*, Vol. 3, Dec. 1930, pages 1087–1089; Vol. 4, Feb. 1931, pages 137–140.

Aluminum sheet increases in both hardness and tensile strength up to a certain limit when cold worked. The percentage elongation, however, decreases rapidly to a fixed low value as the hardness increases. The author gives a table of temper designations, tensile strengths and percentage elongations for 16-gage 2S and 3S aluminum sheet of various degrees of hardness from dead soft to full hard. The elongation is a measure of the drawability of the sheet and an indication of its purity. The temper is usually determined by means of the Shore scleroscope. The bending test, which consists in bending a narrow strip of sheet upon itself, is a useful indication of workability. The most reliable test for drawability is the cupping or ductility test, which closely simulates draw-press action. This is performed on either the Olsen or the Erichsen machine. The cupping test value depends on the temper, thickness, composition, grain size and general quality of the sheet and readily identifies unsuitable material. Coiled aluminum sheet is usually supplied in widths from 1 to 21 in. and from 10 to 36 gage. These coils weigh 40 to 60 lbs. Coil circles are made in almost any practical width from 4 in. to 20 in. and down to 30 gage. Flat sheet varies from 1 in. to 60 in. in width and runs up to 180 in. in length. Bright flat sheet ranges from 10 to 36 gage while gray plate is usually not made lighter than 20 gage. The second part discusses range of sizes, grades and qualities available. Bulk of sheet for drawing purposes is made in the dead-soft temper. 2 grades (2S and 3S) are generally used in the manufacture of drawn and stamped shapes. Commercially pure Al sheet is known as 2S; 3S contains 1.25% Mn and the remainder Al. Great bulk of material used by the stamper is in the form of coils and coil circles, gray-plate strips being used in lesser quantity. Includes table giving Brown and Sharpe gage, thickness in inches and weight in lbs./ft.^{2} of Al sheet ranging from 10–36 gage, the usual range employed in the stamping trades. JN(12h)

Tests on the Properties of Drawn Wire and Power Consumption during the Drawing Process. (Versuche über die Eigenschaften gezogener Drähte und den Kraftbedarf beim Drahtziehen.) W. LINICUS. *Zeitschrift für Metallkunde*, Vol. 23, July 1931, pages 205–210.

The paper discusses the following: properties of drawn brass wires as dependent on the conditions of drawing, comparison between drawn wires and those stretched by pulling; effect of uneven flow of material during the drawing process upon the properties; additional strain hardening and internal stresses due to stretching; hardening of the edge; power consumption during drawing; loss in friction and true share of pulling strength required for the plastic deformation; influence of uneven material flow upon power consumption; checking of theoretical considerations concerning the power consumption with particular reference to the total power required in addition to the pulling stress; influence of die material and influence of the qualities of the rolling material upon properties of the rolled material and upon the power consumption; utilization of laws found on other materials. EF(12h)

Internal Stresses in Brass Tubes. (Innenspannungen in Messingröhren.) A. KRECEK. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, pages 178–185.

The occurrence of large and uneven internal stresses in brass tubes (62–65% Cu) which were drawn with small reductions in diameter and wall thickness precipitated the present investigation. Any influence on the side of varying Cu contents and of micro-structural differences could not be proved whereas there is an important influence due to method of diameter and wall-thickness reductions, form of dies, lubrication and kind of straightening devices. The author furthermore revealed the role which the dimensions of samples submitted to the determination of internal stresses and the accomplishment of the mercury nitrate submersion test are playing. Fundamental principles involved in the evaluation of tension reduction free from stresses are considered. EF(12h)

Forming of Large Stampings for Aircraft. R. E. JOHNSTON. *Metal Stampings*, Vol. 4, Feb. 1931, pages 159–160.

Aluminum alloy sheet is now widely used in airplane construction. The sheet metal department employs a large variety of presses, shears, rolls, saws, etc. A 700-ton hydraulic press with platen 129 in. × 60 in. is used to form large parts for the tail assembly, cowling, fuel tanks, seats, flooring, etc. The required dies are made of reënforced hard maple or of cast steel. This press shapes parts from duralumin, alclad, aluminum, brass, copper and steel. The sheet metal ranges from $^1/_{100}$ to $^1/_8$ in. in thickness. JN(12h)

Machines and Tools for Forming. (Werkzeugmaschinen und Werkzeuge der spanlosen Formgebung.) H. HAAKE. *Maschinenbau*, Vol. 10, June 4, 1931, pages 387–391.

Hot- and cold-working by hammering and in forging machine; rolling out into sheets by cutting, turning, bending; shaping stamping tools as an important new development; progress in construction of special stamping tools; hydraulic and mechanically operated stamping machines; preference for simple crank and eccentric presses for use of pneumatically tested tools; measurement of the power in working machines; the variety (multiplicity) of couplings; increasing safety and load by automatic feeding and removal of tool pieces; special machines. MAB(12h)

The Drawing of Non-ferrous Wires. E. L. FRANCIS & F. C. THOMPSON (Victoria University of Manchester). *Institute of Metals, Advance Copy* No. 568, Sept. 1931, 25 pages.

Tests showed that the tension required to pull a wire through a die is independent of the speed, at least for speeds between 0.0001 and 600 ft./min. The pull is directly proportional to the original tensile strength of the wire. The tension is also proportional to the reduction of area effected. Experiments with various die angles indicated that the smallest tension was required when the semi-angle was between $5^1/_2°$ and 6°. This was for a 20 and a 35% reduction. The best lubricant was a Na soap, but wires of better appearance were obtained with liquid lubricants. A mixture of graphite and oil, "oil-dag," was found to be the best non-solid lubricant. The friction in tungsten carbide dies was less than that in steel dies. This was attributed to the better lubrication of the former due to the inhomogeneity of the microstructure. With liquid lubricants the friction was less in diamond dies than in tungsten carbide dies. Greater tension was required to pull wire through bell-shaped dies than through conical dies. 12 references. JLG(12h)

Accurate Stamping of Dials and High-Grade Nameplates. FRANK V. FAULHABER. *Metal Stampings*, Vol. 3, Dec. 1930, pages 1075–1078.

Gives suggestions for overcoming delays, improving the product, and lessening waste of material and spoilage in the punching of holes, blanking out and other stamping operations where great accuracy is required. MS(12h)

Flow Phenomena in Deep Drawing of Sheet Metal. I. FETSCHENKO-TSCHOPIWIKI & M. OPALKO. *Metal Stampings*, Vol. 3, Nov. 1930, pages 1027–1029; Dec. 1930, pages 1115–1116, 1125.

Translated from *Zeitschrift des Oberschlesischen Berg- und Hüttenmännischen Vereins*, Vol. 69, Dec. 1930, pages 652–658. Sheet-metal normally shows indications of cold working in the form of flow figures on the surface. These flow lines influence the stamping qualities of the metal and the direction of cracks in the Erichsen test. A compression test in which deep drawing takes place at an angle of 30–35° is useful in determining the suitability of steel sheets for deep drawing purposes. Good sheets yield a smooth, straight surface after the stamping. Coarse, crystalline material will always produce cracks, as well as a coarse surface. Good stamping properties can be attained if the C content is 0.09–0.11% and Mn, 0.40–0.50%. Thermal treatment has marked influence on deep drawing properties. Annealing in a temperature range between Ar_3 and Ar_1 favors formation of free cementite at expense of pearlite. As a result, the material becomes very brittle, and in deep stamping, cracks and a coarse surface occurs. Long annealing at temperatures below the allotropic transformation improves drawing properties but produces a certain degree of brittleness. Erichsen test, under such conditions, shows satisfactory results, whereas the deep stamping test causes a rupture. It follows, therefore, that it is necessary to anneal deep drawing stock at temperatures above the allotropic transformations and to cool rapidly, so as to attain a fine crystalline structure and to prevent accumulation of free cementite at the grain boundaries. MS(12h)

Maintenance of Stamping Plant Equipment. L. B. HORNBERGER. *Metal Stampings*, Vol. 3, Nov. 1930, pages 981–984.

Discusses some important maintenance problems encountered with heavy stamping equipment. Points out that a special maintenance department provides systematic inspection and servicing. MS(12h)

Important Considerations in the Checking of Punch and Die Work. ROBERT A. HEYDEN. *Metal Stampings*, Vol. 3, Dec. 1930, pages 1101–1102.

List of questions regarding important points of design. Applicable to blanking and perforating and blanking punches and dies. MS(12h)

The Construction and Uses of Typical Dies. Parts II, III. EDWARD HELLER. *Metal Stampings*, Vol. 4, Feb. 1931, pages 153–154, 166; Mar. 1931, pages 233–234, 242.

Part II. A discussion of 3 types of combination dies. These are all made by adding a piercing operation to a blanking die. The most common type combines the piercing and blanking operations in sequence. A second type, the "compound die" blanks and pierces in one operation, while the third type, which requires a sequence of motions, must be used when the piercing operation is performed close to the edge of the blank. Part III. The design and detailed construction of 3 types of dies with their applications and methods of operation are described. The piercing, cutting and forming type of die makes a small channel in a stamping. The simple forming die bends up small pieces of sheet metal into various shapes. The forming die with a collapsible punch permits the punch to collapse on the up-stroke of the press so as to facilitate the removal of the finished piece. JN(12h)

Pickling (12i)

The Pickling and Cleaning of Metals. II and III. Some Considerations of the Chemical Reactions Involved. DAVID BROWNLIE. *Sheet Metal Industries*, Vol. 4, Oct. 1930, pages 425–427; Nov. 1930, pages 519–520.

The author elaborates on his statement in Part I that corrosion is due to electrical as well as chemical action. He points out the theories of corrosion resulting from electrolytic action and sets forth the relation between theory and practice in the case of pickling where it is desired to remove only the scale. By placing a boiler under definite potential through dynamo connections it has been found that corrosion can be made to cease immediately, even when using salt water, and existing scale comes off. It is suggested that this could be applied to an improved pickling practice. Part III discusses, generally, inhibitors and restrainers used and available for pickling baths. AWM(12i)

Acid Inhibitors in the Pickling of Metals. (Les Economiseurs d'acide dans le d'capage.) GEORGES BATTA & EDM. LECLERC. *Chimie et Industrie*, Vol. 25, Special Number, Mar. 1931, pages 475–483.

The results obtained by adding various inhibitors (gelatin, CH_2O, flour, Na_2AsO_3, anthracene oil from coke ovens and commercial products) to a 20% HCl bath and a 10% H_2SO_4 bath are described. The method used consisted in measuring the volume of H evolved on immersing cleaned sheets of the metal for a given time in the pickling bath, and was found quite satisfactory for comparative purposes. The cleaning of the metal surface before the test considerably affects the results, a much greater evolution of H being obtained by polishing the surface than by cleaning with acid, H_2O and ether, which is attributed to some of the H remaining occluded to the surface of the acid-cleaned metal. In every case, the addition of inhibitor reduced the surface tension of the bath. The value of an acid inhibitor can be determined to a satisfactory degree of approximation by the following tests: (1) determining retardation in the solution of the metal by (a) comparing the losses in weight of identical samples of metal to be treated under the same conditions, in presence and absence of the required amount of inhibitor or (b) by comparing the volume of H evolved; (2) pickling tests consisting in immersing weighed unpickled samples in baths with and without inhibitor and comparing (a) loss in weight, (b) time required for pickling, (c) number of samples which can be pickled in a given volume of bath, (d) appearance of the pickled metal; (3) resistance of the inhibitor to the action of hot concentrated solutions, by heating the bath 6–12 hrs. and then determining the volume of H evolved with a standard sample of the metal. WHB (12i)

Cold Working (12j)

Why Cold-Working Changes Properties of Metal. E. V. CRANE. *Iron Age*, Vol. 128, Sept. 3, 1931, pages 626–630.

This is the third installment of a series of 4 articles on strain hardening. Explains why physical properties of metal change in the process of cold working with or without intermediate annealing. VSP (12j)

On the Cold-Working of Iron. (Sur l'écrouissage du fer.) W. BRONIEWSKI & J. KRÓL. *Comptes Rendus*, Vol. 193, July 6, 1931, pages 38–40.

The authors describe a series of experiments conducted on Armco iron of French manufacture, containing less than 0.15% total impurities. The article is accompanied by 2 diagrams showing (1) the effect of drawing this material upon the elastic limit, tensile strength, percentage elongation and Brinell hardness; (2) the effect of annealing on the hardness and the crystal size of the material; and (3) the effect of various annealing times on the hardness. OWE(12j)

Cold Roll Forming of Metals. Pt. X-XI. D. A. JOHNSTON. *Metal Stampings*, Vol. 3, Nov. 1930, pages 987–990; Dec. 1930, pages 1081–1084.

Discusses factors involved in the design of rolls and accessories necessary to form a special tube-like section with hemmed edge, and the principles of construction and application of combination rolls in the forming of sheet-metal sections. MS(12j)

DEFECTS (13)

What a Heat Treater Should Know about Defects in Steel. GEORGE M. ENOS. *Fuels & Furnaces*, Vol. 8, Nov. 1930, pages 1485–1490, 1542; Dec. 1930, pages 1631–1636.

Outlines methods of examining defective steel and discusses failures due to inclusions, pipe, segregation, etc., in the steel; improper hot or cold work; improper design; faulty heat treating; poor machine-shop or fabricating processes; and use of part in service under stress conditions not originally contemplated. MS(13)

Detecting Defects by Radiography, Using Gamma Rays. CHARLES W. BRIGGS & ROY A. GEZELIUS. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, July 1931, pages 65–92

γ-rays from radium are used to detect internal defects in steel castings. The method is illustrated by a series of radiographs taken on several castings. Film records are correlated with defects found upon subsequent sectioning of the casting. CHL(13)

On Soldering Brittleness. (Ueber Lötbrüchigkeit.) K. KREITZ. *Stahl und Eisen*, Vol. 51, Sept. 3, 1931, pages 1118–1119.

Soldering brittleness is due to the penetration of the soldering metals into the steel and can be avoided when tension stresses are absent during soldering. GN(13)

The Investigation of Sand Inclusions in Steel by Means of the Polarization Microscope. (Die Untersuchung von Sandeinschlüssen im Stahl mit Hilfe des Polarisationsmikroskops.) F. HARTMANN. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 601–606.

Report 174 of the Committee on Materials of the Verein deutscher Eisenhüttenleute. Slags and inclusions of refractories in steel can be distinguished by examining thin sections in the polarization microscope. The origin of refractory inclusions can be detected in comparing the thin sections with those of refractory materials which were in contact with the steel during the process of making. This method offers a possibility of improving the quality of refractories in order to avoid inclusions in the future. GN(13)

The Decarburization on the Edge of Carbon Steels with Simultaneous Scaling. (Die Beurteilung der Randentkohlung von Kohlenstoffstählen bei gleichzeitiger Verzunderung.) E. H. KLEIN. *Stahl und Eisen*, Vol. 51, Aug. 20, 1931, page 1066.

It was found that, during the heat treatment of carbon steels, samples which scaled were less decarburized than those which did not scale. It is, therefore, advised in judging the decarburization of steels to consider, also, the loss due to scaling. GN(13)

Inclusions and their Effect on Impact of Steel. A. B. KINZEL & WALTER CRAFTS. *Iron Age*, Vol. 127, Mar. 5, 1931, pages 781–783.

Abstracts of a paper read before the A. I. M. E., Feb. 18, 1931. Includes discussion. See *Metals & Alloys*, Vol. 2, July, 1931, page 136. VSP(13)

Inclusions and Their Effect on Impact Strength of Steel. II. A. B. KINZEL & WALTER CRAFTS. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 436, Sept. 1931, 10 pages.

Samples from 19 commercial heats of steel were heat treated to give Rockwell B hardness values between 76 and 96. Inclusion counts and transverse tensile-impact tests were made by the methods described in Part I (*Metals & Alloys*, Vol. 2, July 1931, page 136). The tensile-impact test was found to be a satisfactory method for the determination of the dynamic properties, but inclusion count alone was not. It is claimed that the importance of unknown factors comprised in the term "body" as distinct from cleanliness has been demonstrated. Practical limits for transverse tensile-impact strength for steels having Rockwell hardness values between 76B and 96B are suggested. JLG(13)

Embrittlement of Structural Steel. Progress Report of Sub-Committee X of Committee A5, A. S. T. M. V. F. HAMMEL, Chairman. *Advance copy*, to appear in Vol. 31, Part I, *Proceedings American Society for Testing Materials*, 1931, 27 pages.

Includes selected bibliography by S. Epstein and B. N. Daniloff of 175 titles, on blue-heat phenomena, chemical composition and melting procedure, cold work and reheating, pickling, caustic embrittlement, embrittlement of malleable, effect of heat-treatment and embrittlement testing. In rare cases, galvanized structural steel has broken with a brittle fracture under impact. In all such cases, the material has been punched stock. Theories for the cause include hydrogen embrittlement due to pickling, work hardening due to punching, precipitation hardening at galvanizing temperatures, or the combination of several factors no one of which alone would impair the properties seriously. Chemical composition is important, Bessemer steel being inherently more brittle than open-hearth, and normally being excluded from use for heavy angles for transmission towers. Work hardening due to punching is a major factor in producing brittleness. Brittleness is more pronounced at low temperatures. Susceptibility to these embrittling factors varies in different types of steel and to some extent in different heats. Testing for brittleness is carried out by bending a full-sized punched angle to fracture, the "angle bend test." This is a rough test unless made in quantitative fashion. Tensile or bend tests of coupons containing a punched hole also differentiate steel as to degree of embrittlement. These tests and the temperatures at which they are made, need standardization. Preliminary work on this problem for the Utilities Research Commission and for the A.S.T.M. included 2000 tests from 50 heats of steel. Based on the preliminary results, a further research program is outlined to lead to an acceptable test method, to recommended practices for manufacture, pickling, galvanizing and method of making the rivet-holes and to a better understanding of the causes for embrittlement. This includes, among other things, the study of pickling variables, of duplex steel and of the possible effect of N. Material from many sources and in all stages from rolling to galvanizing, is being studied. The study is under the joint auspices of steel makers, galvanizers, fabricators, zinc producers and users of galvanized structural steel, especially public utilities. The steering committee for the co-operative project represents all these interests. The reasons for the inception of the work, a brief statement of the extent of present knowledge and a list of some of the points on which further tests are needed are given. Since the work is only partly complete, no attempt is made in this progress report to prove the correctness of any theory or to set up any specifications or recommended practices, pending completion of research. HWG(13)

CHEMICAL ANALYSIS (14)

Oxidation of Ferrous Iron by Iodine in Presence of Phosphate and Non-Existence of a Ferriphosphate Complex. WALTER D. BONNER & HENDRICK ROMEYN, JR. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 85–87.

7 references. The oxidation of ferrous iron in presence of phosphate and of a moderate concentration of acid goes to completion but the reaction, even in almost neutral solutions, is too slow to be of analytical significance. MEH (14)

The Volumetric Determination of Barium by Direct Titration with Potassium Chromate. (Massanalytische Bestimmung von Barium durch direkte Titration mit Kaliumchromatlösung.) S. BALACHOWSKI. *Zeitschrift für analytische Chemie*, Vol. 82, No. 617, pages 206–210.

The neutral $Ba(NO_3)_2$ solution is titrated with K_2CrO_4 using bromothymol blue or phenol-red as indicator; to both of these reagents K_2CrO_4 reacts alkaline and, hence, a characteristic color change is observed when all the Ba is precipitated. This method is adapted for microchemical analysis. Ha(14)

Determination of Aluminum in Ferrochromium and Chromium Metal. THOS. R. CUNNINGHAM. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 103–104.

In this method, Fe is separated by means of cupferron while Cr is oxidized by evaporating the solution with perchloric acid, and Al is separated by precipitation with ammonia. MEH(14)

Determination of Zirconium in Plain Carbon and Alloy Steels. THOS. R. CUNNINGHAM & R. J. PRICE. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, January 15, 1931, pages 104–106.

Zr is separated from other elements as $ZrHPO_4$ which is converted to ZrP_2O_7 on ignition. A determination may be completed on steels free from W, Sn, Ta or Cb in not more than 2 hrs. The method described is designed to be applicable to any commercial steel. MEH(14)

The Application of the Potentiometric Volumetric Analysis in the Steel Plant Laboratory. Part I. The Determination of Manganese, Chromium and Vanadium Simultaneously. (Die Anwendung der potentiometrischen Massanalyse im Eisenhüttenlaboratorium. I. Die Bestimmung von Mangan, Chrom und Vanadin nebeneinander.) P. DICKENS & G. THANHEISER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 14, 1930, Report No. 158, pages 203–223.

The paper reports the results of investigations on the titration of Mn, Cr and V with solutions of titanium salts. Further experiments were carried on to determine how other elements such as Ni, Co, Mo, Cu and W affect the titration of the above mentioned metals. These metals do not disturb titration. The advantages of the potentiometric titration are rapidity and exactness. See *Metals & Alloys*, Vol. 2, July 1930, page 634. GN(14)

Sampling and Analysis of Red Brass and Other Alloys Having a Tendency to Segregation. (Zur Probenahme und Analyse von Rotguss und anderen zur Seigerung neigenden Legierungen.) O. BAUER & E. DEISS. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 139–142.

It is noted that the great differences often met in analyses of the same composition of ingots can be traced to segregation. This contention was proved by analyzing an ingot of red brass which was divided into several parallel strips, which showed that the contents of Cu increases greatly from the outside to the interior at the sides and the bottom. Sn and, to a lesser extent Pb, are also accumulated greatly in the exterior layers and decrease toward the center. The contents of Zn were fairly constant in all layers. The usually low amount of Sb decreased from the exterior to the center. The amounts of other unimportant metals contained in the alloy do not differ greatly in the different zones. The arrangement of the tests and the results are described in detail and recommendations added how to take samples in order to obtain an average analysis. Ha(14)

Atomic Analysis by Optical Spectroscopy. C. E. EDDY. *Chemical Engineering & Mining Review*, Vol. 23, May 5, 1931, pages 309–312.

An abstract of a lecture delivered at Melbourne University, Apr. 14, 1931. Spectroscopic methods are briefly described, and a different method of plate analysis has been developed in the laboratory of the university. It gives good results for plates taken on a Hilger quartz spectrograph. It produces a spectrum covering a 10″ plate. The plate has been calibrated so that from the position of any line, measured from a fiducial mark on the plate, its wavelength can be instantly and accurately determined. To determine the elements present in an unknown sample, it is only necessary to look for the ultimate lines in certain known positions on the plate. Advantages and disadvantages of the optical method of analysis are listed. Of the 27 elements discovered since 1860, 15 have been discovered as a result of optical spectroscopy, 4 by X-ray spectroscopy, 2 by their radioactive properties and 6 by their chemical properties. It has been conclusively demonstrated that the optical method is particularly suitable for carrying out: (1) complete qualitative analyses of unknown quantities and (2) rapid and certain routine control analyses of both the raw ores and the finished product, particularly where the physical properties of the product are greatly affected by the inclusion of small amounts of impurities. WHB(14)

Rapid Colorimetric Method for Determination of Molybdenum in Plain Carbon and Alloy Steels. THOS R. CUNNINGHAM & H. L. HAMMER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 106–107.

An accurate colorimetric method for the determination of Mo in the presence of Ni, Cr, W and other elements, is given. It is best adapted to steels containing a maximum of 1% Mo. MEH(14)

Effect of Manganese and Aluminum Content of Steel on the Determination of Oxygen, Nitrogen and Hydrogen according to the Hot Extraction Method. (Ueber den Einfluss des Mangan- und Aluminiumgehaltes von Stahl auf die Sauerstoff-, Stickstoff- und Wasserstoff-Bestimmung nach dem Heissextraktionsverfahren.) W. EILENDER & H. DIERGARTEN. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 587–591; *Stahl und Eisen*, Vol. 51, July 23, 1931, pages 944–945.

Report 81 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. In using the apparatus described and in observing temperatures between 1550° and 1600° C. for aluminum bearing steels, there are no difficulties in determining O, N and H in steels containing less than 0.2% Al and 0.6% Mn. Within this concentration range, the values of O, N and H obtained are not remarkably affected. GN(14)

On the Electrolytic Deposition of Traces of Metals and Their Identification by Spectrographic Analysis. (Sur le dépot électrolytique de traces métalliques et leur carcartérisation par l'analyse spectrale.) E. BAYLE & L. AMY. *Bulletin Société Chimie*, France, Vol. 43, 1928, pages 604–624.

Working details are given for the deposition of traces of many of the common metals by electrolysis of appropriate solutions between a Pt anode and a Zn or Cu cathode. The limiting concentrations at which the metals can be deposited on a Cu cathode are as follows: Au 10^{-6}, Ag 10^{-5}, Pb 10^{-10}, Sb 10^{-4}, Co 10^{-5}, Ni 10^{-7}, Fe 10^{-7}, Cu 10^{-8}, Mn 10^{-10}, Zn 10^{-8}. On a Zn cathode Cu may be deposited from concentrations as low as 10^{-7} and Ag 10^{-6}. The original must be consulted for operating details and for the technique used in the spectrographic work. It is stated that rough quantitative results may be obtained by observing in the spectrograph the number and intensity of the lines of the trace of metal deposited. Ha(14)

Quantitative Determination and Separation of Lead and Bismuth by the Volumetric Filtration Method. (Ueber die quantitative Bestimmung und Trennung von Blei und Wismut mittels der Filtrationsmethode.) HANS TH. BUCHERER & F. W. MEIER. *Zeitschrift für analytische Chemie*, Vol. 83, 1931, pages 351–361.

The authors have shown the advantages of carrying out quantitative precipitations with measurement of the volume of reagent required to effect complete precipitation as detected by filtering the solution and testing with more reagent and also with a solution containing the ion to be precipitated. For determining Pb, precipitation as $PbSO_4$, as $Pb_3(PO_4)_2$, as $PbCrO_4$ and as $PbSeO_3$ was tested, and the last 2 methods proved suitable for this kind of analysis. For precipitation of Bi, a 0.015–0.02 *N* solution of H_2SeO_3 is suitable. The Bi-selenite is formed in 0.05–0.08 *N* HNO_3 solution but HNO_3 prevents the precipitation of the corresponding Pb salt. For the determination of Bi and Pb, therefore, make the solution 0.05–0.08 *N* in HNO_3 (0.15 g. Bi or less) and the volume of solution about 100 cc. Heat to 70° and add the H_2SeO_3 solution with shaking. Toward the end of the reaction, heat to boiling. After the determination of the Bi, add an excess of NaOAc, heat to 80–90° and precipitate the Pb (0.1 g. or less) with the same H_2SeO_3 solution or with $K_2Cr_2O_7$ solution. The results obtained in 8 analyses all agreed within 0.23 mg. (1.5% of the Pb content). 18 references. Ha(14)

Method for the Determination of Nitrogen in Steel and Iron Alloys. (Verfahren zur Bestimmung des Stickstoffs in Stahl und Eisenlegierungen.) P. KLINGER. *Archiv für Eisenhüttenwesen*, Vol. 5, July 1931, pages 29–33.

Report 82 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The paper critically surveys the methods which have been used up to the present time for the determination of N in steel and its alloys and the causes and reasons which cause a failure of the common solution method are noted. A new apparatus and method which makes it possible to determine the total amount of N in steel samples, independent of their solubility in acids have been developed and are described. GN(14)

The Estimation of Nickel in Cast Iron. H. W. KEEBLE. *Iron & Steel Industry & British Foundryman*, Vol. 4, Sept. 1931, pages 389–390.

Two methods of analysis are given; one to be used when Ni alone is determined, the other when the analyses of all elements are made. KCN in excess is added to a solution containing Ni. The excess is determined with $AgNO_3$ using KI as indicator. Repeated analyses agree within 0.02%. CHL(14)

Modern Organic Reagents used for the Detection and Determination of Metals. JULIUS GRANT. *Industrial Chemist*, Vol. 7, May 1931, pages 197–200; June 1931, pages 227–230.

In the first part a bibliography of 18 references is given. Methods employed in the use of organic reagents are (1) the use of selective precipitants for certain metals, (2) the use of reagents providing very sensitive and highly selective color tests for small traces of certain metals, (3) methods employing organic titrating reagents and (4) methods employing organic indicators. Gravimetric precipitation reagents discussed are dimethyl glyoxime, salts of xanthic acid, cupferron or copperon, pyridine thiocyanate, quinoline derivatives, cinchonine hydrochloride, etc. In the second part 30 references are given. The reagents are discussed as (1) solvents, (2) colorimetric reagents, (3) volumetric reagents and (4) indicators. The former is often auxiliary to the others. Among the colorimetric reagents briefly discussed are cupferron, Alack's "Alizarin Red S.," pyridine potassium iodide, etc. Among the indicators are the dyes used in acid-alkali titrations, organic indicators used to show the end point in oxidation reduction titrations, and finally, the turbidity, fluorescent and absorption indicators. RAW(14)

The Determination of Moisture in Bituminous Coals and Lignites. (Die Bestimmung der Feuchtigkeit in Stein- und Braunkohlen.) C. HOLTHAUS. *Archiv für Eisenhüttenwesen*, Vol. 5, Sept. 1931, pages 149–162.

Report 86 of the Chemical Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The following determination methods were checked in co-operation with several German steel mill laboratories. (1) Xylol method according to Erdmann. (2) Drying in drying oven at 105° C. (3) Drying in vacuum according to Thlow. (4) Drying at 105° C. and accumulating the water in a medium of absorption. (5) Method according to Kubierschky. (6) Method according to Dolch and Strube. (7) Method according to Zerewitinoff (8) Technical water determination by drying a large sample at 105° C. over night. The results are as follows: (1) The xylol method gives values within the admissible limits of error for any content of water practically to be found in bituminous coals and lignites. The advantage of the method is the direct measuring of the water and, therefore, is suited to determine the true water content of solid fuels. (2) Drying at 105° in drying ovens gives no correct values. It was proven that coals adsorb air during heating and cooling. Furthermore, according to the type of coal oxidation and giving off of volatile hydrocarbons takes place. (3) Drying in vacuum gives the best values of all indirect methods by determining the loss of weight. (4) Although the method gives reliable results, the method cannot be recommended due to its complicated procedure. (5) The Kubierschky method is applicable to coals of a high content of water. (6) The Dolch and Strube method gives results which are in accordance with the xylol method. The method has the advantage of performance in a shorter time. (7) The Zerewitinoff method does not give reliable results. (8) The common method of the practice of drying a sample at 105° C. over night fulfills all requirements. GN(14)

Modified Ford-Williams Method. D. H. JAMES. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 31–32.

The proposed method is applicable to the determination of Mn in high Cr-Ni alloys which are practically insoluble in nitric acid. MEH(14)

Determination of Copper in Dairy Products. H. T. GEBHARDT & H. H. SOMMER. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 24–26.

A new method for the determination of Cu in foodstuffs and biological material has been devised. The method of Elvehjem and Lindow is shortened considerably, the separation of copper sulphide improved and the danger of losses in transfers minimized, by shaking out the precipitated copper sulphide with chloroform instead of separating it by filtering. The ashing temperature should not exceed 565° C. and the time of ashing should be from 3 to 4 hours. Detailed directions are given. 9 references. MEH(14)

Method for Electrolytic Extraction of MnO, MnS, FeS and SiO_2 Inclusions from Plain Carbon Steels. G. R. FITTERER. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 440, Sept. 1931, 15 pages.

Sufficient details are given for the installation of the equipment and for analyzing the residues. The method and results will be fully described in a Bureau of Mines paper now being prepared. Contains 2 references. JLG(14)

Study of Nitrogen in Steels. (Étude de l'azote dans les aciers.) B. GETZOV. *Chimie & Industrie*, Vol. 25, Special Number, Mar. 1931, pages 458–463.

Previous work on the form in which N is present in steel and its effects on the properties of steel are briefly reviewed. Steel parts which had failed in service and which had practically the same composition (P, Mn, C, S, Si) as others which had proved satisfactory, were found to have a much higher N content (about 50–100% higher) than the latter, which proves the great influence of N on the brittleness, hardness and elongation of steel. The author has devised a method (accurate to the 4th decimal place) for determining N in steels consisting essentially in dissolving 10 g. in 50 cc. HCl (d. 1.19), adding 50–75 cc. H_2O, transferring to a 1 liter flask, adding granular Zn and 200 cc. of 15% NaOH, distilling through a Sn condenser into 0.01 *N* H_2SO_4, and titrating with 0.01 *N* NaOH in presence of methyl orange as indicator. The technic of the method is described in detail. WHB(14)

The Analysis of Nickel-Bronze. J. R. GORDON (Ontario Research Foundation). *Canadian Chemistry & Metallurgy*, Vol. 15, Sept. 1931, pages 252–253.

Ordinary methods for bronze analysis have not proven entirely satisfactory when applied to Ni-bronzes. Methods have been adopted whereby a single sample suffices for determining Pb, Cu, Sn, Fe and Ni. Pb is determined as $PbSO_4$, Cu electrolytically with rotating anodes and Ta gauze cathodes, Sn is precipitated as sulphide and weighed as SnO_2, the Ni precipitated with dimethylglyoxime, after oxidation of the Fe by $(NH_4)_2S_2O_8$ and precipitation as hydroxide. WHB(14)

HISTORICAL & BIOGRAPHICAL (15)

Structural and Ornamental Iron Casting in the Last 50 Years. (Der Bau- und Ornament-Eisenguss in den letzten fünfzig Jahren.) TH. EHRHARDT. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Aug. 14, 1931, pages 649–653; Aug. 21, 1931, pages 667–672.

A thorough historical development of styles and types in cast iron ornaments with numerous photographs to illustrate columns, stairs, church decorations, etc. Economical as well as mechanical reasons for changes in styles are discussed. Ha(15)

An Investigation of the Microstructures of Fifteen Silver Greek Coins (500-300 B.C.) and Some Forgeries. C. F. ELAM. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, pages 57–69 (with discussion); abstracted in *Engineer*, Vol. 151, Mar. 20, 1931, pages 327–328; *Engineering*, Vol. 131, Mar. 13, 1931, page 366.

Paper read before the Institute of Metals, Mar. 11, 1931. See *Metals & Alloys*, Vol. 2 Aug. 1931, page 148. LFM(15)

Working Methods of Ancient Coin Manufacture, Especially Counterfeit Coins. (Die Arbeitsmethoden der antiken Münztechnik, insbesondere der Falschmünzerei.) O. DAHL. *Metallwirtschaft*, Vol. 10, Aug. 21, 1931, pages 659–663.

Examination of ancient coins discloses that they were made either by casting in stone or clay or by pressing in bronze or iron dies. Greek coins were all pressed while the larger Roman coins were cast. The counterfeit coins consisted of copper centers with a coating of silver, instead of solid silver. One Roman and two Greek coins were given a thorough microscopic examination. In the Greek coins, the Ag covering was 0.18 mm. thick; in the Roman, only 0.04 mm. In the Greek coins, the center consisted of a cast Cu slug which was placed between two pieces of sheet Ag which overlapped at the edges. This was then heated and pressed in the die. At some points, Cu-Ag solid solution was formed between the pure Cu and pure Ag, at others the heat was high enough to form Ag-Cu eutectic. The structure of the pure Cu and pure Ag sections shows that the temperature was high enough to recrystallize the Cu and Ag, over 780° C. In no case was any solder discovered. In the Roman coin, the covering consisted entirely of Cu-Ag alloy. This could be due to a higher alloying temperature or to the use of a Ag covering alloyed with Cu instead of pure Ag. A reproduction of a coin by the Greek process was attempted and microscopic examination proved that it had the same structure. CEM(15)

The Evolution of Malleable Cast Iron in France. RAYMOND GAILLY. *Foundry Trade Journal*, Vol. 43, Oct. 9, 1930, pages 255, 256.

Abstract of paper read at the Pan-European Foundry Congress at Liege. Chiefly an historical review. In 1922, two 10-ton reverberatory furnaces were installed in France. Later on, the manufacture of black-heart in the cupola was started; on a test bar, this gave a strength of about 20.3 tons/in.^{2} and 8% elongation. In 1926–27, the reverberatory furnaces were modified, enlarged and changed to use pulverized fuel. Annealing furnaces followed a similar evolution. Transformation of melting methods and improvement of annealing control gave to malleable Fe homogeneity and regularity. Ni and NiCr additions are considered and physical properties of plain and Ni bearing malleable Fe are compared. VSP(15)

G. Tammann's Publications on the Chemical Properties of Metals and Alloys. (Arbeiten von G. Tammann über die chemische Eigenschaften von Metallen und Legierungen.) W. KÖSTER. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 142–146.

The fourth article concluding a set of historical reviews of Tammann's research work on the occasion of his 70th birthday celebration covers the following points: the chemical attack and its limitation, the n/8 law, atomistic interpretation and the colored surface films. EF(15)

Friction Bearing in the Last Five Years. (Das Gleitlager im letzten Jahrfünft.) S. KIESSKALT. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 8, 1931, pages 1025–1026.

An historical review of development of this type of bearing in the past 5 years. This development has taken place mainly in the direction of lubricants and the methods of classifying them. With regard to design, it now recognized that lubricating grooves in the surface should always be avoided. Ha(15)

Crystallization and Melting. A Valuation of G. Tammann's Work on the Nature of the Solid State. (Kristallisieren und Schmelzen. Eine Würdigung der Arbeiten von G. Tammann über das Wesen des festen Zustandes.) FR. KÖRBER. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 134–137.

An historical review of G. Tammann's contribution to the problems involved in melting and crystallizing and the significance of his findings with reference to metallurgy. EF(15)

ECONOMIC (16)

Technical Organization of Metallurgical Establishments. (Sull'organizzazione tecnica degli stabilimente siderurgici.) A. CARLI. *La metallurgia Italiana*, Vol. 23, June 1931, pages 485–499.

Comments on the control, measurement and recording of every factor involved in heating processes in a metallurgical plant, in order to reduce cost of production. HWG(16)

Wire Mill Management. E. G. BROWN. *Wire & Wire Products*, Vol. 6, Aug. 1931, pages 325–327.

An efficient organization, plant investment and goods inventory are described and the results obtained in one case are cited. Ha(16)

General View of Coal Industry and Coking Plant Organization in the United States. (Vue d'ensemble sur l'industrie houillere et l'organisation des cokeries aux États-Units.) CH. BERTHELOT. *Revue de Métallurgie*, Vol. 28, July 1931, pages 391–404.

On account of its high quality, only 6.7% of total coal production in the U. S. is concentrated, and 85% of this by wet methods. The general trend of coking plant construction is to reduce to a minimum the first cost of the installation without affecting in any way its efficiency. In small plants, like that at Sterling, Ill., continuous vertical regenerator ovens are used, in larger ones Becker ovens predominate. By using a definite ratio between lumps and fines, rapidly heating the charge after introduction and introducing a quenching chamber at the exit, hangovers are entirely prevented and a remarkable efficiency is obtained at Sterling. Becker ovens have an efficiency about 5 times greater than French installations made before 1926 on account of using silica brick permitting a much higher temperature and simplicity of design of the gas passages. Most of them are being heated by blast furnace gas. Close grading of coal by size is strictly observed. "Pennsylvania crusher" installations observed appear to be decidedly better than any European plant of the same type. Surface condensers for tar removal always used in Europe are replaced here with scrubbers followed by Cottrells while ammonia liquor from the former passes through tubular coolers. Perfect cleaning and continuous operation prevail, the shutdowns occuring only once in 2 years or so instead of one every 2 months as in Europe. The layout of sulphate plants is much better, uniting many installations under the same roof with a great efficiency rather than locating them in different buildings as in continental practice. Thermal control is remarkably good. JDG(16)

Electrochemical and Electrometallurgical Industries of Norway. (Les industries electrochimiques et electrometallurgiques de la Norvege.) KNUDSEN. *Journal du Four Electrique*, Vol. 40, June 1931, pages 210–211.

Abundance of water power led Norway to a rapid expansion of industries requiring it. At present more than 120,000 horse power are developed of which more than 80,000 are used in electrometallurgical plants. An historical sketch of the development is given. JDG(16)

Bauxite and Aluminum in 1929. C. E. JULIHN. *Mineral Resources of the United States*, 1929, Part 1, May 20, 1931, pages 485–506, *United States Bureau of Mines.*

Al was produced in 1929 in only North America and Europe; 132,000 metric tons by the former and 129,900 by the latter, a total increase of about 8% over 1928. The U. S. produced 38.98%, Germany 12.03%, Canada 11.42%, France 11.07%, Norway 10.39%, Switzerland 8.40% and England, Italy, Austria and Spain together 7.71%. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Utah in 1929. C. N. GERRY. *Mineral Resources of the United States*, 1929, Part 1, June 12, 1931, pages 581–635, *United States Bureau of Mines.*

The output in 1929 of Au, Ag, Cu, Pb and Zn from Utah mines increased 21% over 1928 to a value of $95,985,201. Au output increased 13%, Ag 3% in quantity (decrease in value), Cu 9% in quantity and 33% in value, Pb 2% in quantity, and 10% in value, and Zn 9% in quantity and 16% in value. Utah was the leading Ag producer, second for Cu and Pb and fifth in Zn. AHE(16)

Gold, Silver, Copper, Lead, and Zinc in Montana in 1929. C. N. GERRY & T. H. MILLER. *Mineral Resources of the United States*, 1929, Part 1, pages 831–876, July 27, 1931, *United States Bureau of Mines.*

The mine production of Au, Ag, Cu, Pb and Zn in Montana in 1929 was $71,779,547, nearly 30% increase over 1928, largely due to the increase in Cu output from 248,262,027 lb. ($35,749,732) to 297,725,973 lb. ($52,399,771). There were also increases in the output of Ag (17%) and Pb (16%), but decreases in Au (6%) and Zn (18%), the latter more than 29,000,000 lb. Production of Au was 54,758.03 oz., Ag 12,716,977 oz., Pb 39,213,707 lb. and Zn 136,351,734 lb. The state ranked 2nd in Ag production, 3rd in Cu and 4th in Zn. AHE(16)

Iron Ore Mining in Chile and Prospects of a Native Steel Industry. (Der Eisenerzbergbau in Chile und Aussichten einer heimischen Eisenhüttenindustrie.) C. H. FRITZSCHE. *Stahl und Eisen*, Vol. 51, Apr. 30, 1931, pages 541–547.

Report No. 26, of the Committee on Ores of the Verein deutscher Eisenhüttenleute. Chile possesses 2 large iron ore deposits in the desert of Atacama, Algarrobo and Tofo, beside some medium deposits and numerous small deposits which cannot be considered for mining economically. At present, mining by the Bethlehem Steel Company takes place only at Tofo, with a yearly output of about $1^1/_2$ million tons of ore. Approximately $1^1/_3$ million tons of coal are mined in Middle Chile. This coal can be successfully coked in high temperature silica coke ovens. Furthermore, large amounts of charcoal are available; charcoal production, however, is expensive because of the difficult transportation and the high percentage of waste in the raw wood. Large water powers are available all over the country. The steel consumption of Chile amounts approximately to 150,000–200,000 tons/yr. In spite of the premium paid by the government of Chile for the home production of steel (35 M/ton), the project of the building of a steel industry has not yet materialized. The most comprehensive project is the construction of a plant in the Valdivia district which was intended to utilize the power of the Huilo-Huilo River. Although this project has been abandoned, new projects have been made. The cokeability of the Chile coal will play an important role in these projects. GN(16)

Gold, Silver, Copper and Lead in Texas in 1929. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1929, Part 1, pages 761–764, July 23, 1931, *United States Bureau of Mines.*

The gross value of Au, Ag, Cu and Pb produced in Texas in 1929 was $683,920, a decrease from $899,204 in 1928. Au output increased from $10,115 to $26,439 and Pb from 695,570 lb. to 849,683 lb. Ag decreased from 1,340,622 to 1,020,5 16 oz. and Cu from 447,792 to 341,000 lb. AHE(16)

Gold, Silver, Copper, Lead and Zinc in New Mexico in 1929. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1929, Part 1, pages 729–759, July 23, 1931, *United States Bureau of Mines.*

The gross value of the recoverable Au, Ag, Cu Pb and Zn from the 121 producing mines of New Mexico in 1929 was $24,473,675, an increase of 30% over 1928. Output of all the metals increased in amount and value. Production was: Au 35,176.46 oz., Ag 1,121,546 oz., Cu 97,717,262 lb., Pb 22,260,811 lb. and Zn 68,910,000 lb. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Nevada in 1929. V. C. HEIKES. *Mineral Resources of the United States*, 1929, Part 1, July 3 1931, pages 637–673, *United States Bureau of Mines.*

In 1929 the total value of mine production of Au, Ag, Cu, Pb and Zn in Nevada was $33,030,237 or 6% more than in 1928. The quantity and value of Au (6.5%) and Ag (10 and 18%) decreased; the quantity of Cu decreased 12%, but the value increased 8%; and the quantity and value of both Pb (25 and 35%) and Zn (150 and 170%) showed substantial increase over 1928. Outputs were: Au 163,711.22 oz., Ag 4,923,526 oz. Cu 140,138,809 lb. Pb 19,692,568 lb. and Zn 16,920,083 lb. AHE(16)

The Potentialities of South American Markets of Cast-Iron Pipes. R. E. FLINN. *Foundry Trade Journal*, Vol. 45, Aug. 20, 1931, page 118.

A brief summary of business prospects in the more important South American countries. Reference is made to the fact that during 1928 and 1929, only 2 of the South American republics (the Argentine and Uruguay) purchased cast iron pipes from the United Kingdom in any considerable quantity. OWE(16)

Use of Electron Metal Spreads Rapidly in Europe. PAUL FIDRMUC. *Canadian Foundryman*, Vol. 22, July 1931, page 17.

A brief statement, accompanied by 2 photographs, regarding the increasing use of the magnesium-base alloy "Electron," the annual production of which in Germany reaches approximately 6000 tons. OWE(16)

Saving in Costs from New Plant Arrangement. BURNHAM FINNEY. *Iron Age*, Vol. 128, August 6, 1931, pages 366–369.

Describes rearrangement of production facilities and installation of new equipment at the plant of Dodge Brothers, Inc., Detroit. Efficiency in manufacturing trucks has increased 30%. Relocation of final assembly line has saved 60% in handling parts VSP(16)

Rationalization. (Rationelles Arbeiten.) GEISSEL. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 13, 1931, pages 137–142.

Several methods and molding machines are discussed with the object of economizing and rationalizing the molding process. Diagrammatic sketches show the individual stages of molding a piece for quantity production and methods are suggested for supervising the production. Ha(16)

PLANTS & LABORATORIES (17)

North German Refinery. (Norddeutsche Raffinerie.) E. VAN ERCKELENS. *Engineering & Mining Review*, Vol. 132, Aug. 24, 1931, pages 160–164.

Electrolytic Cu, Pb, Ag, Au, Sb, Ni and Cd are the chief products of the refinery. Several illustrations are included, with the description of plant operations. WHB(17)

The Electrical Plant of the Erftwerk A. G. (Die elektrischen Anlagen der Erftwerk A. G.) DUNKER. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July–Aug. 1931, pages 293–295.

The electrical energy for the electrolysis of Al is supplied under 100,000 V. and reduced, in 2 transformers of 30,000 kva. each, to 5,000 V. They have Al windings. The necessary direct current is generated in 15 motor-generator-sets of 3780 kw. each at 250–270 V. Al is extensively used for cables, bus bars, etc. The transformers with Al windings have not had any failure in the 13 yrs. of their operation. Ha(17)

The Hollinger Assay Office. W. R. DODGE. *Canadian Mining & Metallurgical Bulletin* No. 225, Jan. 1931, pages 115–122.

Detailed description. AHE(17)

Steel Ball Manufacture at the Plant of Hull Iron and Steel Foundries. JAMES BREAKY. *Canadian Foundryman*, Vol. 22, June 1931, pages 7–9.

A description of the Hull Iron and Steel foundries at Hull, Quebec, with particulars of certain products in which they are specially interested. The article is accompanied by 3 photographs. OWE(17)

The Empire Zinc Company's Operation at Gilman, Colorado. II. W. O. BORCHERDT *et al.* *Engineering & Mining Journal*, Vol. 132, Sept. 28, 1931, pages 251–261.

The second installment of a series of articles on the construction and operation of the Eagle plant of the Company. This installment concludes a general description of the plant at Gilman, Colo. Subsequent articles will consider in detail various phases of the enterprise. WHB(17)

Seamless Tube Mills at McKeesport. SIDNEY KOON. *Iron Age*, Vol. 127, June 18, 1931, pages 1962–1966, 2008.

Describes new seamless tube mills of the National Tube Co. covering a range of pipe from $3^1/_2$ to 24 ins. outside diameter. Combined annual capacity is 250,000 tons of pipe. Flexibility in handling pipe in various stages is a feature of the layout. VSP(17)

The Electrification of the Sheet Mill at Finnentrop. (Die Elektrifizierung des Feinblech-Walzwerkes in Finnentrop.) R. HERZFELD. *Stahl und Eisen*, Vol. 51, Aug. 13, 1931, pages 1021–1024.

Description of the rebuilding and electrification of 4 rolling mills at the Finnentrop Works of the Wolf Netter & Jacobi Kommandit-Geschellschaft. GN(17)

Specialty Foundry for Electric Alloy Steel Castings. BURNHAM FINNEY. *Iron Age*, Vol. 128, July 23, 1931, pages 246–247.

Describes alloy steel foundry of the Duriron Co., Dayton, Ohio. Concerned chiefly with producing corrosion and heat resistant alloy steel castings. VSP(17)

Canadian Nickel Smelter Boasts World's Largest Pulverized Coal Plant. C. F. HERRINGTON. *Engineering & Mining Journal*, Vol. 132, Sept. 14, 1931, pages 219–221.

The new Copper Cliff smelter of the International Nickel Co. of Canada, Ltd. has the largest pulverized coal plant for metallurgical furnaces. The general arrangement and flowsheet are shown, also several cuts and tables. WHB(17)

The Acton Precious Metals Refinery. BERNARD HOLMAN. *Mining Journal*, London, Vol. 173, May 2, 1931, page 355.

Descriptive. AHE(17)

Shawinigan Stainless Steels. W. M. GOODWIN. *Iron & Steel of Canada*, Vol. 14, July 1931, pages 109–110.

An article accompanied by 4 photographs describing the plant of Shawinigan Stainless Steel and Alloys, Limited. This company manufactures acid-resistant and corrosion-resistant alloys; the furnace equipment consists of 2 Volta electric furnaces. OWE(17)

MACHINERY & SUPPLIES (18)

Weighing and Counting Devices for Materials Handling. A. B. JACOBUS. *Iron Age*, Vol. 127, Apr. 9, 1931, pages 1154–1157.

Abstract of paper read at Cleveland before the American Society of Mechanical Engineers. Gives a number of illustrations, together with brief descriptions of appliances such as cupola charging scales, hopper batching scales, scales for weighing hot metal and railroad tracks, etc. VSP(18)

Pulverized Coal Experiences in a Malleable Iron Foundry. C. F. HERRINGTON. *Iron Age*, Vol. 127, June 11, 1931, pages 1896–1901.

Describes the pulverized coal installation for the Erie Malleable Iron Co., Erie, Pa., that has been in operation since 1924. The erection and placing in operation was done by Heyl and Patterson, Inc., Pittsburgh, Pa. VSP(18)

Correct Power Application in Pressed Steel Plants. O. H. HENSCHEL. *Metal Stampings*, Vol. 3, Sept. 1930, pages 821–824, 832; Oct. 1930, pages 905–908.

Discusses installation of motors for driving presses, to reduce power consumption and improve power factor. Deals with the economic effects and savings resulting therefrom. MS(18)

Electrical Drive of Band-Conveyor Installations. (Elektrischer Antrieb von Band-Förderanlagen.) W. HERBECK. *A. E. G.-Mitteilungen*, Sept. 1931, pages 549–552.

Description of the electrical installation for conveying of 260–300 tons lignite/hr. over a distance of about 570 ft. at a grade of 20 degrees. Ha(18)

Electrical Equipment of a Reversible Blooming Mill in the Steel Plant Esch on the Alz of the Société des Aciéries Réunis de Burbach-Eich-Dudelange. (Equipement électrique d'un blooming reversible installé aux usines d'Esch-s.Alz de la Société des Acieries Réunis de Burbach-Eich-Dudelange.) M. BOUTON. *Revue Technique Luxembourgeoise*, Vol. 23, Mar.-Apr. 1931, pages 49–61.

This mill is for rolling steel ingots of 5 tons; its hourly capacity is 100 tons. In 23–25 passes, the ingot is rolled to sheets. The electrical equipment consists of a reversible d.c. motor of 8000 HP continuous at 59–140 r. p. m. and a maximum torque of 280 meter-tons; maximum output, 23,000 HP at 59 r. p. m. It is supplied by an Ilgner motor-generator-set consisting of an asynchronous 3-phase motor, 3000 volts, 42.5 periods, 4500 HP, driving 2 DC generators each of 3375 KW, 625 volts, 500 r. p. m. or 2700 KW, 500 volts, 400 r. p. m. The maximum output is 10,000 KW. The flywheel runs with a peripheral speed of 117.5 m./sec. and has a flywheel effect of 540 tonmeter.[2] It works with 20% speed drop. The starting machine, excitor group, control boards, diagram of connections and operation is described in detail. Ha(18)

MISCELLANEOUS (20)

Building Reliability Into the Pressure Vessel. F. O. LEITZELL. *Chemical & Metallurgical Engineering*, Vol. 37, Sept. 1930, pages 566–567.
Factors which must be considered in design of pressure vessels are safety, simplicity, expansion and contraction, metal composition and ease of fabrication, safety in operation being the prime requisite. Adequate testing is imperative. MS(20)

Scrap Control in Implement Manufacture. GEO. LAIDLER. *Canadian Foundryman*, Vol. 22, July 1931, pages 14–16.
A description of the organized procedure followed by one firm in its endeavor to control the wastage of iron and steel in the manufacture of agricultural implements. The article is accompanied by a diagram which might be described as a flow sheet of the various materials entering the works. OWE(20)

Caution in the Changing of Cleaning Agents of Acetylene-Generators. (Vorsicht beim Auswechseln der Azetylenentwickler.) FREYTAG. *Oberflächentechnik*, Vol. 8, Sept. 1, 1931, page 189.
Two very grave accidents occurred in a locomotive factory where the workmen were exchanging the cleaning agents in acetylene generators. Both suffered a complete paralysis of the sensorial system of the face and mouth. This was attributed to poisonous vapors rising from the cleaning mass which had not been changed early enough. Both cases seem incurable. Ha(20)

Progress in Coking Practice in 1930. (Fortschritte im Kokereiwesen in Jahre 1930.) W. HECKEL. *Stahl und Eisen*, Vol. 51, June 25, 1931, page 794.
The author briefly reviews 11 different important papers dealing with the recent progress in coking practice. GN(20)

The Magnetization of Permanent Magnets with a High Current Dynamo. (Das Magnetisieren permanenter Magnete mittels Hochstromdynamo.) R. A. HAMANN. *Automobiltechnische Zeitschrift*, Vol. 34, Sept. 10, 1931, pages 559–560.
A detailed calculation of an electromagnet fed by a dynamo for the magnetization of permanent magnets. Ha(20)

Empirical Control of a Simple Equation for Actual Gases. (Empirische Kontrolle einer Gleichung für reale Gase.) E. J. M. HONIGMANN. *Forschung auf dem Gebeite des Ingenieurwesens*, Vol. 2, July 1931, pages 261–266.
The actual gas equation is defined. The determination of its value for various materials by means of tests and tables is explained. MAB(20)

Conservation Through Baling Bulky Scrap. HENRY JACOBSON. *Iron Age*, Vol. 128, Aug. 6, 1931, pages 374–375.
Sheet scrap baling can be divided into 3 groups: (1) sheet and tin plate mills which bale trimmings from sheets they manufacture; (2) manufacturing plants producing stampings; and (3) scrap yards, which bale accumulation of new scrap. The value of scrap lies in the conservation of Fe ore. VSP(20)

Recovery of Tin-Bearing Wastes. V. FROELICHER. *Textile World*, Vol. 80, Sept. 19, 1931, page 35.
The Sn contained in the water used for washing weighted silks is recovered in modern plants by neutralizing the Sn-bearing wastes by the addition of a milk of lime slurry, continuously added from an agitating tank controlled by routine chemical analysis of the final discharge to the river. The rate of flow of the Sn-bearing water is about 1600 gal./min. It contains about 90 mg./liter of Sn salts with a value of $150.00/day. These figures are from the recovery plant of the Hawthorne Works of Textile Dyeing and Printing. Ha(20)

The Running Properties of Light Metal on Nitrided Steel. (Ueber die Laufeigenschaften von Leichmetall auf Nitrierstahl.) LEON GUILLET. *Automobiltechnische Zeitschrift*, Vol. 34, Aug. 20, 1931, pages 528–529; *Genie Civil*, Vol. 51, 1931, pages 489–495.
Experiments made with piston rods of the Al alloy, "Alugir" of the composition Cu, 3.5–4%; Ni, 0.5–0.9%; Mg, 0.5–1%; Si,0.3–0.75% are described. These rods were running without a bearing metal directly on the crankshaft and piston pin. Since the light metal has about twice the expansion coefficient of steel, very careful measurements of the holes and diameters of the individual parts were made at different temperatures from −10° to +150° C. In spite of the comparatively great differences, no practical difficulties were encountered; this is very likely due to the better heat conductivity of the piston rod which remains colder and expands less. The saving in weight and mass in the piston rod is considerable, although the section has to be larger. Ha(20)

The Development of an Electron Emitting Alloy. O. S. DUFFENDACK, R. A. WOLFE & D. W. RANDOLPH. *Metal Industry*, London, Vol. 38, May 22, 1931, pages 527–528.
Extended abstract of paper presented before the Electrochemical Society, April 1931. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 186. PRK(20)

Electrically Driven Rollers and Their Application. (Die Elektrorollen und ihre Anwendung.) W. ALBRECHT. *Stahl und Eisen*, Vol. 51, July 23, 1931, pages 929–935.
Report 86 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The article discusses the advantages and disadvantages of electrically driven rollers for various purposes, with special reference to new types of roller constructions as they are applied in rolling mills for the transportation of rolled material. GN(20)

The Superintendent's Point of View. J. R. BAUSCH. *Steel Founder*, Vol. 1, Nov. 1930, pages 14–15.
Relation between selling of steel casting and quality production; need of rigid inspection method. Ha(20)

A Noble Profession: Makers of Copper Boilers. (Une profession d'élite: La chaudronnerie en cuivre.) G. DUBOIS. *Cuivre et Laiton*, Vol. 4, Aug. 30, 1931, pages 379–382.
The importance of coppersmiths in former times is pointed out in a brief historical sketch. Belgium and Germany are especially referred to. The author advocates the extension of this art, especially to light metals now so widely used, notwithstanding the competition of steel. Ha(20)

Novel Pattern Methods Devised to Make Decorative Castings. JAMES BREAKEY. *Canadian Foundryman*, Vol. 22, July 1931, pages 7–9.
A description of some of the architectural metal work which is being produced at the foundries of the Architectural Bronze and Iron Co., Toronto, Ontario. The article is accompanied by 4 photographs. OWE(20)

Development and Installation of the Hawkesworth Detachable Bit. CHAUNCEY L. BERRIEN. *Transactions American Institute of Mining & Metallurgical Engineers*, 1930, pages 139–167.
Includes discussion. See *Metals & Alloys*, Vol. 1, May 1930, page 527. (20)

Related Class-Room Training for Foundry Apprentices. S. M. BRAH. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Sept. 1931, pages 312–335.
A survey of related instruction given foundry apprentices in plant and municipally conducted training courses. CHL(20)

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FOUNDRY PRACTICE & APPLIANCES (22)

Cheap Melting: The Merits of Modern Crucible Furnaces. G. S. WATSON. *Foundry Trade Journal*, Vol. 45, July 23, 1931, page 58.

A short article dealing with progress lately made in designs of crucible and open-flame furnaces, emphasizing the value of the former type of equipment from the viewpoint of flexibility and economy. OWE(22)

The Use of Refined Metals in the Foundry. D. R. TULLIS. *Foundry Trade Journal*, Vol. 44, May 7, 1931, pages 321–326, 328.

An article dealing with the chlorine refining process which involves the use of boron trichloride. The use of this refining material in connection with the manufacture of aluminum castings is discussed, the article being accompanied by 32 photographs showing, among other things, the changes in structure produced by modification as a result of the refining process. OWE(22)

To Hold Casting Boxes Down or to Clamp Them in Machine-Molding. (Kasten beschweren oder Kastenklammern in der Maschinenformerei.) H. TILLMANN. *Die Giesserei mit Gieserei-Zeitung*, Vol. 18, Jan. 9, 1931, pages 37–39.

The clamping together of casting boxes instead of loading them down can often relieve the workman of much additional heavy work. A few clamping methods are described. Ha(22)

Eliminating the Shell Defect in Ingot Molds. D. J. THOMAS. *Iron Age*, Vol. 128, July 30, 1931, pages 310–311.

Shell defect in ingot molds is a serious matter which demands constant care. The shell will be found to run the entire length of mold and situated always in the 4 angles. It never appears on flat surfaces of the mold. Serious trouble comes from defect when shell is found deeply embedded in 4 angles. Shell is due to segregation of phosphide eutectic. Rapid corner cooling for ingot molds is advocated to avoid shell defects. Emphasizes importance of using suitable sand. VSP(22)

Recent Investigations on Quality of Piston Rings in Relation to Manufacturing Process. (Neue Untersuchungen über den Gütgrad von Kolbenringen in Abhängigkeit vom Herstellungsverfahren.) N. STERN. *Automobiltechnische Zeitschrift*, Vol. 34, Feb. 16, 1931, pages 89–93.

Recent investigations on quality of piston rings in relation to casting method revealed that, although beyond certain limit of rings in single ring casting, the pot casting method is connected with less expense, nevertheless the latter yields a product of lower quality. According to the author's data, the tensile strength of single cast ring is about double that in ring cut out from bushing and bending strength 50% higher. By aid of micrographs shown in the paper, the author attributes the higher quality of singly cast ring to finer distribution of graphite and uniform structure throughout the cross section. Centrifugal casting may confer similar structure to piston ring, however, because, owing to the non-uniform rate of solidifying, the internal strains are set up. Various testing methods for roundness and distribution of stresses are discussed. ER(22)

X-Ray as Production Tool to Improve Quality of Aluminum Alloy Castings. E. M. GINGERICH & H. J. ROWE. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Aug. 1931, pages 174–196.

Detection of blow holes, porous spots and shrinkage are of value in improving methods of gating, feeding and pouring. Experience is necessary to properly interpret X-ray data. CHL(22)

Economy in the Operation of a Foundry. (Sparsame Wirtschaft im Giessereibetrieb.) FREYTAG. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Jan. 30, 1931, pages 93–94; Apr. 3, 1931, page 282; May 15, 1931, pages 408–409.

Patterns for a group of castings can often be replaced advantageously by templates and core boxes. The castings made in this manner differ less in dimensions than those made in molds from patterns. Examples of 2 molds—one from a pattern and one made with a template and cores—are used to illustrate the manner in which savings can frequently be realized by using the second method. Suggestions are given as to the manner of avoiding hollow spaces at the joint of core-parts so that no burner or seam is formed which must be removed by a time-consuming process, later. Ha(22)

A Method for Molding a Rope Pulley. ARTHUR GREENHALGH. *Foundry Trade Journal*, Vol. 45, July 30, 1931, page 70; *Canadian Foundryman*, Vol. 22, Aug. 1931, pages 17, 22.

An article accompanied by 2 diagrams, in which a method is described of making a rope pulley by means of which a well-balanced casting can be secured. OWE(22)

Investigation of Core-Binding Materials. (Kernbinderuntersuchung.) K. HUETTENES. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 6, 1931, pages 124–126.

A classification of the materials for binding cores and of the principal requirements which such materials must satisfy is given. Methods of testing cores are discussed. Ha(22)

The Task of the Foundry in the Operation of Steel Plants. (Die Aufgaben der Giesserei im Hüttenbetriebe.) K. HOFFMANN. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 27, 1931, pages 264–266.

The products of an iron works foundry are discussed in the relation they have to their field of application and the equipment required. It is emphasized that for an uninterrupted operation of the plant the foundry is absolutely essential but no other products except those required for the operation of the steel plants should be manufactured. Ha(22)

The Casting of Motor Pistons. (Etwas über das Giessen von Motorkolben.) R. FISCHER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 10, 1931, pages 301–303.

Describes a few novel features in modern manufacture of pistons. They are now usually made as die castings in a metal mold; the exact centering of the core is the subject of several patented arrangements. The material is usually an Al alloy which offers lightness with sufficient strength and low expansion. Several forms of molds are illustrated. Ha(22)

Crucibles for Melting Aluminum. (Kroezen Voor het Smelten van Aluminium.) A. JAESCHKE. *De Gieterij*, Vol. 5, July 1931, page 88.

Graphite crucibles with a binder of neutral loam are used for melting Al. Oxidation is kept down by covering the outside with 2 or 3 layers of waterglass. The adsorption of Si by the melt is minimized by coating the inside with a paste made of molasses and calcined magnesite. HSvK(22)

Experiments with Fuel Oil in the Cupola. J. R. HYDE. *Foundry Trade Journal*, Vol. 44, May 21, 1931, page 354.

Abstract of paper read before the Sheffield Branch of the Institute of British Foundrymen, in which a description is given of experiments made with a cupola of the usual type, fitted with 2 rows of tuyères, 3 in each row, the upper row being 8 in. above the lower. Fuel oil was sprayed into the cupola through the upper tuyères. The charges of coke were reduced by half the usual weight, reliance being placed upon the oil to supply the rest of the heat. Working conditions were modified as shown below:

All coke melting—2 cwts. coke.. 16 cwts. pig and scrap
Oil melting—1 cwt. coke 16 cwts. pig and scrap
6 gals. or 60 lb. oil 16 cwts. pig and scrap

The factors favoring the use of oil were found to be (1) slightly lower S content in the Fé, (2) hotter metal and (3) cleaner and less dump. Disadvantages of the process were, extra air service at 20 lb./in.^{2}, extra cost of fuel, extra trouble to regulate, and waste due to high percentage of CO in the escaping cupola gases. On the whole, there does not appear to be much advantage in the use of oil from an economic point of view. OWE(22)

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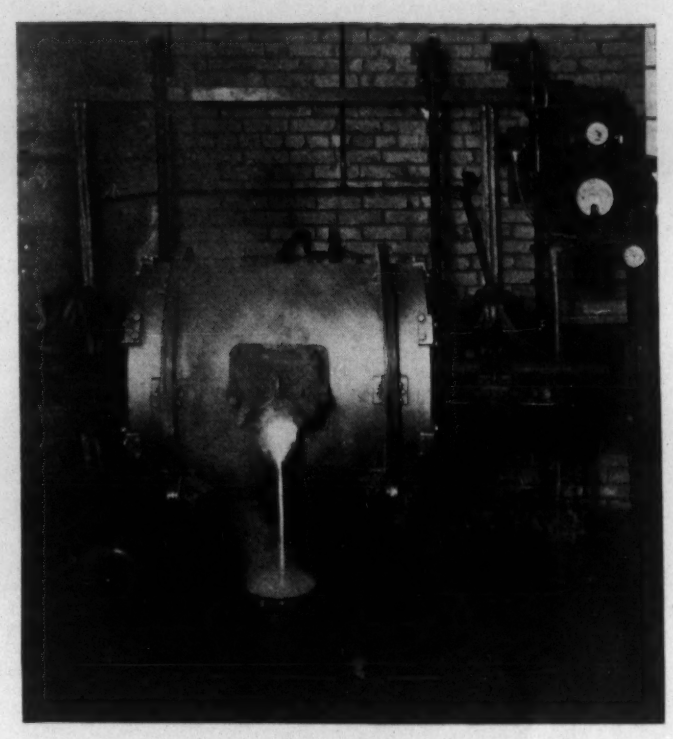

Small (250 lb.) Detroit Electric Furnace Pouring Heat of Alloy Steel

These furnaces manufactured in capacities from 250 lbs. per hour to 6000 lbs. per hour, offer unusual economy in the production of grey iron, malleable iron, alloy steel, or non-ferrous castings showing the highest possible quality. The rocking action of the

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insures complete homogeneity and uniformity, as well as physical characteristics of a highly superior character in the finished castings. Over 50 DETROIT ELECTRIC FURNACES are in use in melting or duplexing grey iron or alloy steel, and over 400 furnaces are in use in the non-ferrous foundries throughout the world.

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DETROIT MICHIGAN

Making of a Cast Iron Funnel with Two Connections in Four Parts with Loam Core. (Herstellung eines gusseisernen Trichters mit zwei Stutzen in vierteiliger Form mit Lehmkern.) R. LOEWER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 22, 1931, pages 422–424.

A few illustrations demonstrate the making of a 4 part mold with templates. The costs of the casting when templates are used are compared with the costs when using patterns and a complete wood pattern. The first method is cheaper. Ha(22)

Mould-handling Methods in Foundries. WILLIAM L. HARTLEY. *Iron & Steel Industry & British Foundryman*, Vol. 4, Aug. 1931, pages 361–365. General. CHL(22)

The Standardization of Core-Boxes of Wood. (Ueber Normung von Kernkasten aus Holz.) F. FREYTAG. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 698–703.

An attempt has been made to develop directions for the manufacture of core-boxes of wood considering kinds of wood, arrangement of the wood in the construction and the dimensions of the core-boxes. Standard core-boxes are illustrated; the outer dimensions have a definite relation to the profiles of the core and to the kind of wood (pine or alder). Ha(22)

New Apparatus for Determination of Moisture in Foundry Sands. (Nouvel appareil pour la détermination de l'humidité des sables de fonderie.) ANDRÉ GUEDRAS. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Mar. 1931, pages 129–130.

With this apparatus, which was invented by Dr. Toedt, moisture content of foundry sands can be determined in a few seconds. It consists of 2 electrodes and a battery which generates the current. The relative moisture can be determined by hydrolysis through the water of the sand. GTM(22)

Molding and Casting a Foundation Plate. (Het Vormen en Gieten van een Fundatieplaat.) G. L. FRUITHOF. *De Gieterij*, Vol. 4, Nov. 1930, pages 184–187.

Design of a mold with directions for molding and casting a large foundation plate (5 × 3.5 × 1.5 m.). HSvK(22)

Molding Sand. (Over Vormzand.) G. HOFSTEDE KOOPMAN. *De Gieterij*, Vol. 5, July 1931, pages 90–91.

The requirements for good molding sand are briefly indicated. HSvK(22)

Furnaces for Melting Cast Iron, Particularly the Brackelsberg Furnace. (Over ijzersmeltovens, meer in het bijzonder den Brackelsbregoven.) G. HOFSTEDE KOOPMAN. *De Gieterij*, Vol. 5, Jan. 1931, pages 1–6.

Includes discussion. A general description of cupola furnaces and oil-fired furnaces is followed by an outline of the Brackelsberg furnace which uses powdered coal as fuel. This type of furnace, introduced in 1927, is now employed by several German and Dutch foundries. HSvK(22)

Acid-Proof Castings. (Zuurbestending gietwerk.) GUST. KREBS. *De Gieterij*, Vol. 5, Apr. 1931, pages 47–49.

Modern practice for making acid-proof castings favors the use of high Si alloys. This requires either a crucible, oil-fired or electric furnace in preference to a cupola furnace. Addition of Ni even in percentages as low as 0.5% is beneficial. High temperatures and quick melting are required. This is readily attained with oil-fired, drum-shaped, rotatory furnaces. HSvK(22)

Molding of a Hollow Base with Template. (Schablonenmässige Herstellung der Form zu einem schalenförmigen Untersatz.) R. LOEWER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, June 12, 1931, pages 482–483.

Detailed description of the molding process. Ha(22)

Progress in Foundry Practice in the First Half Year of 1930. (Fortschritte in Giessereiwesen im ersten Halbjahr 1930.) H. JUNGBLUTH & P. A. HELLER. *Stahl und Eisen*, Vol. 51, June 11, 1931, pages 772–775.

The article reviews the literature on the subject noted above, covering (1) structure and properties of cast iron, (2) melting practice, (3) molding and cleaning, (4) standards, testing, etc. GN(22)

Testing the Hardness of Chilled Castings. II. (Die Prüfung der Härte von Schalenhartguss.) O. KEUNE. *Krupp'sche Monatshefte*, Vol. 12, Jan. 1931, pages 9–16.

The article gives the results of comprehensive tests on the application of the Brinell test in testing chilled cast iron. The errors involved are due to: (1) the ball impressions being off-round, (2) the occurrence of cracks along the edges of the impressions, (3) the kind of ball used. It is shown, however, that a satisfactory accordance between various readings can be obtained; the deviation generally does not amount to more than 1% from the mean value. The Brinell test may, therefore, be used successfully in testing chilled castings. GN(22)

Melting in the Metal Foundry. (Die Schmelzerei in der Metallgiesserei.) A. KRETZLER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 31, 1931, pages 624–627.

Different methods of firing for melting metals are discussed and examples are given of the calculation of the cost of operation of a coke crucible, tilting gas crucible, oil-fired tilting furnace and an electric furnace. These methods are compared. The economy of the melting plant depends on the investment in the melting furnaces, their efficiency, the price of fuel and the daily melting capacity. The two last mentioned factors determine the selection of the most economical furnace. Ha(22)

The Determination of the Piece-Time in Foundries for the Production of Manually Molded Castings. (Die Stückzeitbestimmung in der Giesserien bei Herstellung von handgeformten Gussstücken.) GÉZA JANDL. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 20, 1931, pages 157–162.

The methods for determining the price per piece to be paid to the workman for a single and quantity production are discussed. A new, more exact, way is described which is based on volume, surface and peculiarities of the piece under consideration. Several examples illustrate the method which is being applied at present and a few results are given. Ha(22)

Aluminum Castings. (Het Gieten van Aluminium.) GUST KREBS. *De Gieterij*, Vol. 4, July 1930, pages 112–115.

Sand-cast Al should be poured into molds made with sand which is not packed too tightly. Porosity due to the presence of gases or shrinkage may be avoided by casting at higher temperature and by providing means for an even solidification. The best castings are obtained in properly vented iron molds. HSvK(22)

Some Notes on the Structure of the British Foundry Industry. VINCENT C. FAULKNER. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, June 1931, pages 1–19.

Review of the situation as to foundries in the various branches of industry. CHL(22)

Capacity Increase of Molding Machines by Suitable but Simple Means Using Existing Pattern-Plates and Molding Boxes. (Leistungssteigerung von Formmachinen durch zweckmässige aber einfache Hilfsmittel, unter Benutzung der vorhandenen Modellplatten und Formkästen.) W. GOETZE-CLAREN. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 20, 1931, pages 162–165.

The manner in which molding boxes of different sizes and pattern-plates of unequal heights can be made generally useful for pin-lifting machines is shown. The increase of capacity obtained does not require more wages nor investment of capital. Ha(22)

Castings of Automobile Pistons. (Het Gieten van Zuigers voor Automobielmotoren.) L. HELDER. *De Gieterij*, Vol. 5, June 1931, pages 79–81.

A brief description of modern practice of casting automobile pistons with an alloy containing 85% Al and 15% Cu in preheated cast iron molds. The alloy is poured at a temperature of 720–760° C. HSvK(22)

Molding Practice for Heat-Treated Aluminum Alloy Castings. LEWIS H. FAWCETT. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Sept. 1931, pages 297–311.

Methods and precautions necessary in the production of castings of Al with 4–5% Cu are outlined. Prevention of cracks and checks is considered from molding, core-making and design standpoints. CHL(22)

The Speed of Rotation in the Centrifugal-Casting Process. J. E. HURST. *Foundry Trade Journal*, Vol. 45, Sept. 3, 1931, pages 145–147.

The author considers mathematically the conditions governing the movement of liquids under the influence of centrifugal force when rotated in containers; he obtains equations by means of which values for a constant can be calculated. This constant can be employed in determining the relationship between peripheral velocity and diameter of casting. The article is accompanied by 5 figures and particulars are given in tables of the rotational speeds which have been used in various processes for the centrifugal casting of pipes, etc. OWE(22)

Note on the Influence of Superheating Molten Cast Iron. J. E. HURST. *Foundry Trade Journal*, Vol. 43, Nov. 20, 1930, page 351.

Gives results of experiments on the effect of superheating molten cast Fe on its physical and mechanical properties. Experiments made on castings produced by centrifugal process. The tensile strength, stiffness and Brinell hardness are slightly higher in superheated material. Superheated material is liable to extensive unsoundness. Loss in Si content is about 0.4%. Superheating produces a grayer Fe. VSP(22)

The Effect of the Treatment of the Melt on Gas Content and Shrinkage of White and Gray Cast Iron. (Einfluss der Schmelzbehandlung auf den Gasgehalt und die Schwindung von weissem und grauem Gusseisen.) P. BARDENHEUER & W. BOTTENBERG. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 11, 1931, Report 181, pages 149–159; *Stahl und Eisen*, Vol. 51, July 16, 1931, page 917.

Four white and 4 gray cast irons were tested. The effect of superheating the liquid iron on gas content and shrinkage, in particular on the expansion with beginning solidification, was studied. The total amount of gases, H and CO, were determined by the hot extraction method. A special instrument was designed to take shrinkage curves. The cast irons were superheated at various temperatures and cast in sand molds. With the white cast irons, shrinkage and gas content increase with superheating time and temperature. Gray cast iron expands more during the solidification, due to the formation of graphite so that the gas content has a less pronounced effect. Gas content and expansion also increase with the superheating temperature. In pouring into preheated molds (540° C.) gas content and expansion are smaller, since with slow cooling a large amount of the gases escapes before solidification. A gray cast iron, remelted several times and always heated at the same temperature, shows a gradual decrease of the gas content and a corresponding decrease of the expansion. The expansion during solidification has a bearing on the total shrinkage which may vary by 10% according to the treatment of the melt. GN(22)

Properties of Molding Sands. (Einiges über Eigenschaften der Formsande.) A. AULICH & W. LEWERENZ. *Giesserei*, Vol. 17, Sept. 5, 1930, pages 875–878.

In making the compression test on molding sands, a special device is fitted to the machine which shows the "yield point" that is, the load at which the sand test piece commences to bulge. If this value is plotted as a percentage of the final crushing load, it is found that the figure gives an indication of the clay content and grain size of the sand. Ha(22)

Removing Sand from Deep-Cored Pockets. J. J. BAUM. *Iron & Steel of Canada*, Vol. 14, May 1931, page 1.

Chemical methods that may be adopted for removing sand from pockets in castings are described and reference is made to materials which can be employed as inhibitors of metal attack. OWE(22)

Storage and Preparation of Molding Materials. (Lagerung und Aufbereitung von Formstoffen.) FR. BROBECK. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 6, 1931, pages 197–200.

The preparing plant of a foundry of medium size is described, taking into account delivery and storage of the raw materials. The preparation of the single materials takes place separately according to wet or dry casting with the use of simple machines. A lay-out of the plant and its equipment is given. Ha(22)

Investigation of Core-Oils. (Onderzoek van Kernolies.) W. BAUKHAGE. *De Gieterij*, Vol. 5, Aug. 1931, pages 97–103.

Using washed river sand between 60 and 100 mesh in the ratio of 10 portions of coarse to 3 parts of fine sand, the author made a number of determinations of tensile strengths with oil-sand cores. Comparative tests were performed with linseed oil, linseed oil varnish, core-oil 2, Smithco 2 and Kordek Corebinder, the last named containing potato starch as a binder. The following factors affecting the strength were studied: (1) percentage of oil, (2) period of drying and (3) temperature of drying. With 1% of oil and a drying period of 2 hrs., the highest tensile strengths were obtained for a drying temperature of about 200° C. With increasing percentage of oil, other factors being equal, the tensile strength increased but not regularly. In some cases, a decrease in tensile strength was noted when there was more than 3% oil. Among other factors which influence the results, the following are discussed: (1) the age of the core; (2) the method of mixing oil and core sand; (3) the preparation of the moist sand; (4) the temperature of the sand; (5) the air circulation in the drying oven; (6) the temperature of the cores when tested. Core binders containing flour should be dried at once for obvious reasons. A sample of "Quella," for instance, gave cores which were the weaker the longer they were left alone before being dried. HSvK(22)

Electric Process Iron for Cylinder and Cylinder-Head Castings. H. E. BROMER. *Iron & Steel Industry & British Foundryman*, Vol. 4, Sept. 1931, pages 399–402.

Both the duplexing and cold-melting process are used, depending on demands for castings. Electric process has the advantage of controlling C and Si contents of cast Fe. Uniformity in Brinell hardness is claimed for the superheated electric Fe. A general comparison of transverse tests on plain and alloyed cast irons is given. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. CHL(22)

Systematic Distribution of Overhead Expenses in the Foundry. (Die planmässige Unkostenbewirtschaft in der Giesserei.) W. BREMER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 3, 1931, pages 277–281.

Discussion of costs for labor and material. A systematic check-up of expenses of a foundry is shown in diagrams and tables. Ha(22)

Modern Practice in Non-Ferrous Foundries. (Neuzeitliche Arbeitswesen in der Metallgiesserei.) E. BECKER. *Zeitschrift für die Gesamte Giessereipraxis*, Vol. 51, Oct. 26, 1930, pages 173–174; Nov. 2, 1930, pages 177–178.

Treatment of scrap and secondary metal is discussed. Foundry cleaning methods are also considered. Ha(22)

Casting of a Bed Plate of a Large Lathe. (Exécution d'un bati de grosse machine outil.) M. CONSTANT. *Revue de Fonderie Moderne*, Vol. 25, July 25, 1931, pages 261–266; Aug. 10, 1931, pages 281–287.

Detailed discussion of methods of molding, arrangement of cores, casting, buoyancy forces on the cores, etc., for very large pieces. The advantages of molding in a trench or half-trench are compared. Ha(22)

A Comparison of Natural Bonded and Synthetic Molding Sands for the Steel Foundry. H. J. COLE. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Aug. 1931, pages 161–173.

See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. CHL(22)

Chemical Composition as Employed for Classifying Carbon and Alloy Steels for Castings. R. A. BULL. *Transactions & Bulletin, American Foundrymen's Association*, Vol. 2, Sept. 1931, pages 257–274; *Iron Age*, Vol. 128, July 16, 1931, pages 174–175, 207.

The present confusing state which exists with regard to designation of various grades of steel castings is discussed. A suggested classification consisting of 2 principal groups for castings is proposed. One group subdivided the steel castings to be considered into 9 divisions as being of the regular carbon grade; the other group or 3 divisions includes those steel castings that are considered as being of the special carbon grade. CHL+VSP(22)

Molding and Casting of Centrifugal Pumps. (Het Vormen en Gieten van een Centrifugalpomp.) M. BROSTRÖM. *De Gieterij*, Vol. 5, June 1931, pages 74–77.

Experience has taught that vertical molding of centrifugal pumps of large dimensions produces the best castings. A detailed description of the molding of a centrifugal pump weighing 130 tons is given. HSvK(22)

Bronze Pressure Castings. J. E. CROWN. *Metal Industry*, N. Y., Vol. 29, Aug 1931, pages 335–337.

Among the alloys used for pressure castings is Cu 87.25: Ni 0.75: Sn 9: Zn 3, twice melted and poured around 1950° F. Machine finish allowance should not be excessive for pressure castings. PRK(22)

"Ratching" of Molding Sand. (Het Bratsen van Vormzand.) J. DERLAGE. *De Gieterij*, Vol. 4, June–July 1930, pages 89–93, 107–111.

Includes discussion. The various ingredients of molding sand are discussed and an attempt is made to explain the formation of scabs on castings. Scabs are supposed to form largely as a result of incomplete escape of gases. Casting imperfections due to faulty casting can be avoided by suitable design of gates, sprues and runners. Insufficient porosity may be caused by (1) sand of non-uniform grain size, (2) sand with too much clay, (3) uneven distribution of coal and (or) clay, (4) too much coal, (5) too lean sand, (6) too hard packing and (7) incomplete drying. HSvK(22)

Principles of Molding for Steel Castings. (Etude sur le moulage de l'acier.) P. CROISET. Dunod, Paris, 1931. Paper, 7 × 10 inches, 206 pages. Price 64 Fr.

This is a somewhat contemplative discussion of steel molding practice from a broad point of view. The methods of avoidance of shrink holes, gas holes, warping and other defects are discussed with emphasis on their fundamental causes. The discussion is not very specific, and the book might be classed as dealing only in generalities. But as the treatment is thought-provoking, the book is valuable.

Considerable space is given to a discussion of the solubility of gases in steel, which raises many questions without answering them. Incidental comments on metallurgical phases of steel foundry practice and on the properties of molding sands are given too briefly to be very informative. It is stated that to obtain cast steel without blowholes, the most common practice is to use 0.4–0.8% Mn, 0.2–0.4% Si, and 0.1–0.15% Al, which would indicate that the French founder uses rather large doses of Al. HWG(22)-B-

Malleable Iron. H. H. EBERT. *Iron & Steel Industry & British Foundryman*, Vol. 4, June 1931, pages 293–294.

General. CHL(22)

Casting Operation in Iron and Steel Foundries. H. H. EBERT. *Iron & Steel Industry & British Foundryman*, Vol. 4, Oct. 1930, pages 3–4.

Discusses those tasks which must be done and measures which must be taken in the foundry to bring the liquid iron or steel from the melting furnace to the casting mold, treating particularly the overcoming of hydrostatic pressure, transporting of the metal, casting appliances, inclined castings and pouring temperatures. CHL(22)

Brass and Bronze Founding. H. C. DEWS. *Metal Industry*, London, Vol. 36, Jan. 17, 1930, pages 93–96.

Deals with some of the more important uses and with the technique of founding. The necessity of further research is considered. The products of brass and bronze foundry are divided into 2 groups: ingots and castings. Casting conditions are somewhat different in brass foundries than in bronze foundries. The several uses of bronze call for somewhat different compositions of alloys. The major production of bronze is of alloys of medium Sn content. Most brass alloys are readily mechanically worked and find their chief use in engineering. VSP(22)

Making a Bend Pipe Core in Oil Sand. THOMAS DAVIS. *Iron & Steel Industry & British Foundryman*, Vol. 4, Aug. 1931, pages 367, 370.

Descriptive. CHL(22)

Technical Control in Manufacture of Cast Iron Pipe. T. C. EARNILL. *Canadian Foundryman*, Vol. 22, Apr. 1931, pages 9–11.

Reference is made to the sand most suitable for pipe-casting, to the ideal core material and its preparation, to the condition of the iron most satisfactory for the production of pipes and of iron mixtures which have served satisfactorily in this connection. The article is accompanied by a photograph, showing the casting of a pipe in a sand-spun mold. OWE(22)

Plywood in the Pattern Shop. F. C. EDWARDS. *Foundry Trade Journal*, Vol. 45, Aug. 20, 1931, pages 119, 122.

An article accompanied by 5 figs. which assist in making clear the uses to which plywood may be put in the pattern shop. OWE(22)

The Use of Fluorspar in the Cupola Furnace. (Het Gebruik van Vloeispaat in dem Koepeloven.) F. B. M. DEURVORST. *De Gieterij*, Vol. 4, Aug. 1930, pages 125–134.

Contains 14 references (mostly German). Partial replacement of "hardstone" (a variety of limestone, containing 52.7% CaO, 2.1% Al_2O_3, 1.2% Fe_2O_3) by fluorspar does not affect the melting process. A slight attack of the furnace lining is, however, noticeable. The slag is free from fluorine. The harmful effect on the vegetation is unmistakable. HSvK(22)

Molding a Large Cushion Block. (Het Vormen van een groot Kussenblok.) L. DESMEDT. *De Gieterij*, Vol. 4, Aug. 1930, pages 130–132.

Full directions for molding a cushion block of 7500 kg. The importance of proper venting to avoid formation of scabs is particularly emphasized. HSvK(22)

Producing Hydraulic Cylinder Castings. E. LONGDEN. *Iron & Steel Industry & British Foundryman*, Vol. 4, Jan. 1931, pages 115–118.

The author has chosen the production of a single heavy casting 20 tons in weight (a hydraulic cylinder) which will serve to illustrate the craft of molding and the practical application of foundry metallurgy. Three methods for patternwork, molding and coremaking are discussed and compared. CHL(22)

FURNACES & FUELS (23)

Possibilities of the Electric Furnace. (Les possibilites du four electrique.) PAUL MARTHOUREY. *Revue de Métallurgie*. Vol. 28, Feb. 1931, pages 101–116; Nov. 1931, pages 139–150.

A review of the development of the electric furnace since its conception is given under the heading of different countries. Weak and strong points of it in connection with the industrial peculiarities of the countries are discussed. The present tendencies favor a 3-phase Heroult furnace on account of its simplicity, long life of lining and bottom. The power installed per ton doubled within the last 10 years. The voltage needed depends on the types of the operations to be conducted and the materials used. Higher voltages are to be preferred from economic considerations. Electrical equipment should be calculated to withstand an overloading 5–10 times higher than the normal load. The choice of the electrodes depends on many factors. A set of specifications both for furnace and transformer installations is given. Electric furnace offers particular advantages for deoxidation and production of clean steel by permitting control of time and temperature as well as slag. It is applicable to the manufacture of a number of alloys and steels a list of which is given. Starting with cold scrap and having the bath well deoxidized before Si addition, it is possible to produce uniformly transformer sheets with 3.5–4.0% Si having the losses between 1 and 1.3 watt for 10,000 gausses and 50 cycles in sheets 0.35 mm. thick. Electric cast irons give a much tougher product than the cupola, often 1.5–3 times as resistant to impact as the former. Electric irons are particularly suited for black heart malleable. For white heart a simple treatment as for the former cannot be applied and a proper adjustment of composition, quenching, the speed of annealing and the oxidizing medium must be considered. In the manufacture of rails the defects of all other steel making methods are emphasized. Segregations demand too high a rolling temperature. Insufficient deoxidation when the metal is still boiling in the ingot mold interferes with the proper pouring temperature and too fast a rolling accentuates the troubles. Rapid carburization leads to a coarse grain without having any strength at high temperatures. Carburization with anthracite should be avoided. Much better results are obtained when the steel is brought to the proper carbon content gradually. Electric furnace offers a very valuable tool for manufacture of rails, which have very good physical properties, thus justifying the extra cost. Steel castings made in an electric furnace have better physical properties than those made by any other process. As an example of the products which can be made in it is given a Ni-Cr steel with better properties for railroad work than 13% Mn steel. It was described previously (Paul Marthourey. "Les aciers speciaux resistant à l'usure pour appareils de voie." *Revue mensuelle de l'Industrie des Voies ferres et Transports automobiles*, Dec. 1929, Jan. 1930) and only results of physical testing are given here. A set of rules for economic operation of electric furnaces is offered. JDG(23)

Electric Gas Purification in a Gas Producer Plant. (Elektrische Gasreinigung im Gaserzeugerbetrieb.) H. KNICKENBERG. *Stahl und Eisen*, Vol. 51, Mar. 26, 1931, page 390.

The article briefly describes the two-step Cottrell electric gas purification unit installed at the Böhler steel plant at Düsseldorf-Oberkassel for the separation of tar and oil from producer gas generated with Rhenish bituminous coal. Data on the cost of operation, are given. GN(23)

More about Furnace Atmospheres and How to Make Them Behave. W. W. KEMP. *R-S Industrial Review*, No. 31, July 1931, page 6.

A few general remarks on producing and maintaining required atmospheres with gas burners and different arrangements for mixing gas and air. Ha(23)

The Transformation of Mixed Gas in the Open Hearth Furnace. (Die Umwandlung des Mischgases im Siemens-Martin-Ofen.) W. HEILIGENSTAEDT. *Stahl und Eisen*, Vol. 51, Aug. 20, 1931, pages 1045–1056.

Report 214 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. It is shown that the reactions of mixed gas in the open hearth furnace can be quantitatively studied by means of the equilibrium conditions of the water gas reaction and the CO_2–CO reaction, provided the constants of equilibrium of the water gas and the CO_2-CO reaction are known. These constants were determined in the special case of this investigation. The constants were used to study the effect of the water vapor content of the mixed gas upon the carbon separation and the heat consumption of the reactions. Up to a saturation temperature of 20° C., the effect of the vapor is of relatively minor importance but the carbon separation decreases with an increase of the vapor content of the gas, so that no free C appears at temperatures around 50° C. Simultaneously with increasing vapor content, the heat consumption of the reaction increases and, therefore, the preheating temperature can be decreased. The temperature relations and the heat transfer in the gas checkers and its effects upon the gas reactions in the furnace were also studied. GN(23)

The Rotating Furnace, Stein-Brackelsberg, for Melting Cast Iron Heated by Powdered Coal. (Le four rotatif Stein-Brackelsberg chauffé au charbon pulvérisé pour fusion de la fonte.) JOUANNO. *Revue Technique Luxembourgeoise*, Vol. 23, May–June 1931, pages 93–105.

This furnace can be moved in 2 directions in the vertical plane. It is used for making malleable iron and cast iron of high resistance. The advantages claimed for this type are: Heating with powdered coal allows complete combustion without excess of air and the possibility of obtaining high temperatures without oxidation of the metal. The slag on top of the melt protects the metal from action by air and combustion gases. The loss due to burning is very small, in contrast to the cupola process. The analysis of the melt differs very little from the analysis of the charge. Because of the rotating motion, the bath is heated not only at the surface, but the heat which is stored in the walls is recuperated. This accelerates melting and lengthens the life of the furnace lining. Temperatures of 1500° to 1550° C. can be obtained without fear of oxidation. The safety of the heating system against explosions assures regularity of production. The average time required for a melt in a 5 ton furnace is about 3 hrs. The paper is supplemented and illustrated with complete details of analyses of product and charge, performance of furnace, heat balance and micrographic examinations. Ha(23)

Two-Chamber Regenerative Gas Furnaces with Constant Flow. (Fours à deux chambres au gaz régénérateur et à courantgazeux continu.) HENRY FEY. *Revue Technique Luxembourgeoise*, Vol. 23, Jan.-Feb. 1931, pages 20–28.

A general description of the development of the furnace with a divided horseshoe flame is given and it is shown that the low thermal efficiency has prevented its wider application. A new improved construction is characterized by the division of the air current coming from one of the regenerative chambers. One part enters the furnace by pressure and by tube burners and passes on in a continuous flow. The other part is used for the combustion of the cold gas directed directly against the openings of the regenerative chamber; the flame serves for the direct heating of the regenerative air chamber. Three new models of this furnace are described. Test results are reproduced which showed an efficiency of the chambers of more than 85%. Ha(23)

Present Tendencies in Heat-Treating Furnaces. (Tendances actuelles des fours pour traitements thermiques.) M. FOURMANT. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 291–298.

General discussion of requirements and the methods by which they are met. Lists various types of continuous furnaces. HWG(23)

A Study of the Combustible Nature of Solid Fuels. R. V. Frost. *Heating, Piping & Air Conditioning*, Vol. 3, Sept. 1931, pages 771–777.

A number of charts are presented showing the relationship between draft and rate of combustion for samples of several different fuels. The fuel requiring the smallest amount of draft to maintain combustion is charcoal, producing 1.3% ash. The next on the list is coke, with 10.0% ash. Next come 2 types of anthracite producing 10.8 and 27.9% ash, respectively. A sample of Rhode Island graphitic anthracite, producing 22.4% ash, is next on the chart. This type of fuel offers so high a resistance to combustion that it is not offered for sale as a fuel. Yet this supposedly valueless anthracite apparently will burn much more readily than Pennsylvania anthracite, with 7.6% ash, the curve for which is last on the chart, requiring the greatest amount of draft to produce combustion. It is apparent that the usual tests of coal fail when applied to the determination of the combustible character of the coal. Neither appearance, density, chemical composition nor location can be used as an indicator. The only positive means of determining the combustible character of a coal before it is put to use is to make a specific test for that particular purpose. WAT(23)

Heating of Mixers with Blast Furnace Gas. (Le chauffage des mélangeurs par gaz de haut fourneaux.) Chas. D'Huart. *Revue Technique Luxembourgeoise*, Vol. 23, Mar.-Apr. 1931, pages 76–83.

Up to the present time, this method of heating has been used very little. A few installations which are operated experimentally and can, in an emergency, be switched over to other gas supplies are described. See also *Metals & Alloys*, Vol. 2, Apr. 1931, page 87. Ha(23)

Use of Blast Furnace Gas. (Quelques considérations sur l'utilization rationnelle du gaz de haut fourneau.) M. Gangler. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th Session Liege, June 1930, pages 55–71.

Describes practice at the Differdange plant. HWG(23)

Roasting and Heating in America. (Roste und Feuerungen in Amerika.) Hans Heitler. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, May 1931, pages 155–156.

Abridgment of article presented before the Prime Movers Committee of the National Electric Light Association, June 1929. MAB(23)

The Principles of Design of Cupola Furnaces, the Determination of Their Size and Their Mathematical Relations. (Die Rechnungsgrundlagen des Giessereischachtofens, ihre Grössenbestimmung und mathematische Gesetzmässigkeit.) A. Achenbach. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 13, 1931, pages 217–225; Mar. 20, 1931, pages 241–245.

The conditions and the principal factors of the performance of a cupola furnace are theoretically discussed and practical formulas developed which are later proved to hold good in actual tests. It can be stated that the principal factors, i. e., charge, amount of air, coke and volume of the cupola form fixed mathematical relations from which no deviations are admissable. The calculations are given in detail and 23 references are cited. Ha(23)

Operation of Buess Hocker-Type Rotary Furnace. (Die Arbeitsweise des Buess-Schankeldrehofens.) W. Buess. *Giesserei*, Vol. 17, Nov. 14, 1930, pages 1121–1122.

The advantages of an eccentrically arranged rocker furnace over the usual drum furnace are discussed and an example is given which shows better mixing in the bath. Ha(23)

Practical Applications of Heat in Metallurgy. Harry Dobrin. *Iron Age*, Vol. 128, July 16, 1931, pages 180–181, 208.

Abstract of a paper read before Association of Iron & Steel Electrical Engineers in Cleveland, June 17, 1931. In contrast to the high efficiencies in the boiler plant, general efficiencies in metallurgical heating hardly average 20% for most reheating processes. In sheet and tin mill industries, the general efficiencies are about 18%. The author discusses the method he uses in fuel economy and gives the results obtained. VSP(23)

Automatic Combustion Control Systems for Wire Furnaces. F. Aschner & H. Mayer-Witten. *Wire & Wire Products*, Vol. 6, July 1931, pages 292–294; Sept. 1931, pages 363–365.

Describes regulating systems developed in Germany, types of regulators, methods of operations and results of service. The importance of automatic furnace control, particularly in the manufacture of wire, is pointed out. Economy of the process and quality of the product depends largely on the furnaces. The second installment describes temperature control and pressure control apparatus used in German installations. Ha(23)

Experiences with Stationary and Tiltable Open-Hearth Furnaces with Mixed Gas Heating. (Erfahrungen und feststehenden und kippbaren Siemens-Martin-Oefen mit Mischgasbeheizung.) H. Bansen. *Stahl und Eisen*, Vol. 51, Aug. 6, 1931, pages 989–995.

Report 211 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The article describes the furnace operation with mixed gas heating, considers tests to suck larger quantities of waste gas through the gas checkers, studies the effect of the humidity of the gas and the gas composition by analysis and the effect of the furnace type upon the gas composition. GN(23)

Industrial Furnaces for Gas. IV. Heat Treating Pot Furnaces. V. Heat Treating Oven Furnaces. VI. Heat Treating. Muffled, Combination and Rotary Furnaces. VII. Special Furnaces for Heat Treating. VIII. Forging. Rivet Heaters. Lawrence E. Biemiller. *American Gas Journal*, Vol. 134, May 1931, pages 57–59; June 1931, pages 39–41; July 1931, pages 48–49; Aug. 1931, pages 47–48; Sept. 1931, pages 54–56.

IV. Defines the various terms used in heat treating Considers specifically the cyanide furnace, the lead hardening furnace, oil tempering furnaces and temperature control on pot furnaces. V. This article considers single deck low temperature oven furnaces, single deck high speed steel furnaces and double deck furnaces. VI. The difference between "standard" and "special" furnaces is defined: the former is made in definite sizes and is available from manufacturers' stock; the other is made to individual specification. The small combination furnace, permitting several kinds of heat treating on a small scale, the muffled oven furnaces, combination furnaces for general tool work and rotary carburizers are described. VII. The article considers 2 typical furnaces for hardening, one which can be used for either hardening or annealing, one annealing furnace with 2 conveyors operating in opposite directions, as well as one continuous normalizing furnace which gives a very specialized anneal. Each type is described and its particular advantages and applications evaluated. VIII. The different forging temperatures for different steels are given and discussed. The application of the forging operation in rivet heating is described and advantages explained. MAB(23)

Characteristic Properties of Foundry Coke. (Kennzeichnende Eigenschaften von Giessereikoks.) F. Brinckmann & A. Nehmitz. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, June 26, 1931, pages 515–516.

Besides limited moisture, ash and content of S, coke for cupola furnaces must also have a certain strength. A method by which an objective impression may be gained is described. It consists of a "drop-drum" test. A drum 1 m. in diameter and 1 m. long which rotates for 4 mins. with 25 r. p. m. is filled with 50 kg. of coke. After this, the coke is sorted by means of sieves; parts of more than 40 mm. are designated as strong; from 20 to 40 mm., as brittle; and the parts under 10 mm. as abrasive. The results of such a test are said to show great regularity. Ha(23)

Electric Reflection Furnace. (Elektrischer Reflexionsofen.) C. Benedicks & J. Haerdén. *Teknisk Tidskrift*, Vol. 61, 1931, pages 149–155.

The construction and operation of an electric reflecting arc furnace with an elliptical Cu mirror are described. It is particularly suitable for vacuum work. The principal advantage consists of the melting of substances of high melting temperature without bringing them in contact with foreign materials, especially crucible walls; moreover, in the short time of bringing the temperature up, 2000° C. can easily be reached. An efficiency of 25% of the total energy supplied to the electric arc has been obtained. Ha(23)

Oil or Gas as an Industrial Fuel. G. F. Beach. *R-S Industrial Heat Review*, No. 31, July 1931, pages 3–4.

A few general points of comparison for deciding upon the use of oil or gas. Ha(23)

A Study of Heat Regenerators. (Étude sur les appareils régénérateurs de chaleur a inversions.) Defrance & Sanger. *Revue de Métallurgie*, Vol. 28, June 1931, pages 305–323; July 1931, pages 367–374; Aug. 1931, pages 426–447.

The calculation and design of heat regenerators do not present any particular difficulties from the theoretical standpoint but the results obtained by different investigators are pronouncedly different. The present work is a comprehensive mathematical analysis of the methods used. JDG(23)

Fuel Impregnation by the Slag in the Hearth and Bosh of the Blast Furnace. C. D. Abell. *Foundry Trade Journal*, Vol. 43, Dec. 11, 1930, page 410.

The fuel in a cold blast furnace becomes impregnated with slag. The several types of impregnation products are: the amber slag which occurs as an interstitial mineral in association with coke in the hearth; the mineralized fuel, occurring with amber slag in central zone of hearth is essentially a silicified C, retaining fuel ash in chemical combination; and white slag, obtained by burning away of mineralized fuel and is low in Fe and Mn content. VSP(23)

Cost of Dry Methods of Gas Purification. (Étude du prix de revient des 1000 M³/hr de gaz épuré dans les épurations modernes pax voie sèche.) M. Derclaye. *Congrés International des Mines de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 9–24.

Includes discussion. Comparison of cost of bag filtration vs. electrostatic precipitation of dust from gas to be used for gas engines, etc. with the advantage usually in favor of the bag system. The discussors disagreed and preferred wet methods to either of the dry methods. HWG(23)

Determination of Time Required for Heating of Steel. T. J. Ess. *Iron & Steel Engineer*, Vol. 8, July 1931, pages 317–321.

Information from various sources is assembled and correlated. Variables are so numerous as to make each case an individual problem. Ten items are enumerated which must be considered. Certain rules for the determination of time required for heating steel are given. $Y = C(e)^{mx}$ relates time, Y in minutes, to x, temperature in ° F. desired in the stock where C and m are constants for the given furnace temperature and have values as follows:

Furnace Temp.	C	m.
2100° F.	1.75	.002025
2450	2.9	.00135
2680	3.25	.000965

Allowable temperature difference from center to outside limits the rapidity of heating. This factor is of greatest importance in heat treatments and of least importance in reheating operations. For a given shape the time for the surface to approach the furnace temperature is proportional to the thickness. Temperature difference in the stock is proportional to the thickness. With stock 4" thick diffusion is the controlling factor and on thin stock the surface absorption of heat controls the heating time. A factor called diffusivity is inversely proportional to the heating time and is composed of conductivity/(specific heat × density). Effects of furnace size and flame conditions are discussed. Qualifications to the rules for determining time of heating are tabulated. An equation to act as the basis for the construction of a chart for forge furnace heating is given by $t = a\,V^m/O^n$ where t is the time, V stock volume, O stock surface, a and m constants determined by test. Times for heating various sizes of stock 1" to 7" to temperatures of 1000–1800° F. with a furnace temperature 200° F. higher are tabulated. These data show the effect of recalescence which is important in heat treatments. The times determined by the five rules given are compared in a tabulation. Discrepancies and applications of the rules are discussed. Charts are shown which eliminate the necessity for mathematical skill in the application of two of the rules, one of which is most applicable to heat treatment operations. WLC(23)

REFRACTORIES & FURNACE MATERIALS (24)

Refractory Materials for the Induction Furnace. J. H. Chesters & W. J. Rees. *Iron & Steel Industry & British Foundryman*, Vol. 4, July 1931, pages 347–348; *Foundry Trade Journal*, Vol. 45, Aug. 13, 1931, pages 105–107; Aug. 20, 1931, pages 113–114.

Paper read at the annual meeting of the British Iron & Steel Institute in London, in which the authors discuss linings for horizontal ring-type and corcless-type induction furnaces. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 190. OWE+CHL(24)

A New Source of Raw Materials for High-Temperature Heat Insulation. J. Bryte Barnett & R. H. Heilman. *Proceedings Engineers' Society of Western Pennsylvania*, Vol. 47, July 1931, pages 349–371.

The bulk of refractory materials consists of but three chemical compounds, silica, alumina and combinations of these in the form of clays. Of these silica and clays have been extensively used in the production of heat insulating materials, but alumina has had but little application until recently. The following table gives the thermal conductivities of the powdered materials investigated:

Material	Conductivity B. t. u./ft.² hr./° F./inch 1000° F.	1600° F.	Loss on Ignition Percent
Monohydrated bauxite	0.713	0.935	16.3
Alumina (Bayer process)	2.010	2.820	1.0
Alumina (fusion process)	3.710	5.180	0
Alumina fume	0.750	1.175	1.8
Aluminum monohydrated	1.160	1.540	17.4
Aluminum trihydrated	2.400	3.240	34.7
Bauxite residue	0.650	0.870	16.3
Bauxite residue floated	0.420	0.650	12.9
Bauxite	2.680	3.410	30.3
Diatomite	0.864	1.134	5.0

The following table presents the thermal conductivities of the molded insulation investigated.

Molded Insulation	Recommended Temp. ° F.	Conductivity B. t. u./ft.² h./° F./inch 1000° F.	1600° F.
"Superex" block	1600	0.966	1.270
Natural "Sil-o cel" brick	1600	0.925	1.170
"Sil-o-cel" C22 brick	2000	1.750	2.220
"Sil-o-cel" C25 brick	2500	2.100	2.540
"Nonpareil" brick	1600	1.160	1.420
"Armstrong" brick	2500	1.920	2.620
Monohydrated bauxite brick	1900	0.710	0.910
Aluminum monohydrated brick	2500	1.950	2.500

WAT(24)

GASES IN METALS (25)

Dissolved Nitrogen Embrittles Weld Metal. F. R. HENSEL & E. I. LARSEN. *Metal Progress*, Vol. 20, Sept. 1931, page 44–47.

Technique for the prevention of gas absorption during welding is described. Age hardening effects in metal deposited in welds without precautions for preventing the absorption of nitrogen are discussed. Microphotographs show the distribution and condition of the nitride after various treatments. If the Ni is held below 0.05%, age hardening effects are greatly reduced or eliminated. WLC(25)

Influence of the Atmosphere on the Scaling of Mild Steel. W. H. BLACKBURN & J. W. COBB. *Journal Society Chemical Industry*, Vol. 49, Nov. 28, 1930, pages 455T–462T; Dec. 5, 1930, pages 463T–466T.

Small specimens of mild steel were heated for 3 hrs. at 1000° in various atmospheres and the increase of weight was determined. The loss of metallic iron, when no excess of O was present, was found to be 0.43% with oil as fuel and 0.24% with coke. With 3% O in the atmosphere, the losses were 1.27% and 1.09%. The exclusion of O is of the greatest importance, if the scaling is to be minimized. The addition of 0.5% O results in rapid scale formation. The mixing of the fuel gas with O and the elimination of free O should be completed before the metal is reached. In the absence of free O scaling was definitely lessened by fuels which were rich in C and low in H. The use of high-temperature coke with a low moisture content is recommended. The influence of the addition of various reducing gases to the furnace atmosphere upon complete prevention of scaling and upon 50% reduction of scale formation was determined. The amount of reducing agent necessary to secure complete absence of scaling or even a reduction to 50% was much larger than could be used in ordinary practice, representing a quantity of potential heat of the same order as that of the primary fuel. H was the most effective agent for the complete prevention of scaling, involving the least thermal expenditure, while CO involved the greatest. Even with H as anti-scaling agent, however, the thermal expenditure amounted to 1.3 or 0.8 times the thermal value of the fuel, depending on whether oil or coke was used. The thermally stable methane was much less effective than either ethylene or acetylene, which are both readily decomposed by heat. The free C (soot), however, present in a smoky atmosphere, was found to have a negligible effect in preventing scale. A clear atmosphere, with the same reducing gases, CO and H, was found to be equally effective. In adding CO and H to the furnace atmosphere, the former was found to be more efficient up to the point where scale formation was reduced 43%. Beyond this, H was more efficient. There seems to be no ground for assuming that a smoky reducing flame from bituminous coal would be any more effective in minimizing scaling than a clear reducing flame from coke. The "neutral" atmosphere from coke would be definitely less scaling than that from coal on account of the lower content of water vapor. Ha(25)

INSPECTION (26)

Inspection on an 18-Story Welded Building. A. R. ELLIS. *Welding*, Vol. 2, July 1931, pages 440–443.

Over 13,000 lineal feet of welding were examined by the stethoscopic method. The construction was speeded up by a patented erection seat welded to one member whereby the number of guy lines could be reduced. Ha(26)

Welding Inspection. R. KRAUS. *Canadian Foundryman*, Vol. 22, Aug. 1931, pages 12–15.

Paper presented at a symposium on welding under the auspices of the A. W. S. and the A. S. T. M. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 152. OWE(26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Nickel in Cast Iron. W. T. GRIFFITHS. *Foundry Trade Journal*, Vol. 43, Nov. 27, 1930, pages 369, 370.

Includes discussion. Abstract of paper read before the Wales, Monmouth and West of England Branch of the Institute of British Foundrymen at Cardiff. Reviews various researches which have been carried out. Ni acted the same as Si in regard to graphitizing. Si should be lowered when adding Ni if best results are to be obtained. Ni is used to avoid porosity in castings. Use of Ni in cast Fe and also with Cr produces a wear-resisting material. VSP(27)

The Dependence of the Magnetic Induction of Structural Steels upon the Chemical Composition. (Die Abhängigkeit der magnetischen Induktion bei Baustahlen von der chemischen Zusammensetzung.) E. GEROLD. *Stahl und Eisen*, Vol. 51, May 14, 1931, pages 613–615.

Report from the Research Institute of the United Steel Works at Dortmund. Steels containing 0.03–0.10% C and not more than 2% of Al, Si, Cu, Ni, Mo, Mn and Cr were tested. The induction was determined for various field strengths and compared with that obtained by calculation. The measured and calculated data are in satisfactory agreement for higher field strengths above 7.7 ampere turns/cm. Therefore, the induction can be calculated from the chemical composition. GN(27)

Influence of Small Additions on the Softening of Copper. (Einfluss von kleinen Zusätzen auf die Enthärtung des Kupfers.) ARTHUR BURKHARDT. *Metallwirtschaft*, Vol. 10, Aug. 21, 1931, pages 657–659.

Contains 7 references. Alloys containing 0.1% and 0.5% of Ag, Si, Fe, Zn, Cd, Al, Ni, Cr, Mg, Sn, Mn and P with electrolytic Cu were cast, hot pressed at 900°. They were then reduced 50% by cold rolling, cut in several pieces, annealed for 2 hrs. at from 250° to 550° C. and tested for Brinell hardness. The results are given in tabular and graphic form. All additions raise the softening temperature somewhat, especially 0.5% additions of Ag, Fe, Cr, Mg, Mn and Sn. Mg and Sn have a distinct hardening effect on Cu. Fe and Cr alloys which were quenched from 900° before cold working have a higher softening temperature than those which were cooled slowly, due to formation of alloys affected by heat treatment. CEM(27)

Some Modern Alloy Steel Developments. BASIL BARHAM. *Iron & Steel Industry & British Foundryman*. Vol. 4, Sept. 1931, page 411.

General. CHL(27)

Some Properties of Austenitic Gray Cast Iron. (Sur quelques propriétés des fontes grises austenitiques.) MARCEL BALLAY. *Comptes Rendus*, Vol. 193, July 6, 1931, pages 47–49.

The author describes the results of certain experiments on the effect of Cu, Al and Cr on the properties of gray cast irons having an austenitic structure. In particular, a mixture containing 2.71% total C, 1.45% Si, 1.30% Mn, 14.82% Ni, 1.40% Cr and 0.30% Cu was investigated. To this material Cu was added in such proportions as to give a series of alloys containing from 0.30 to 12.25% Cu. The author remarks that the solubility in the solid state of Cu in ordinary cast Fe is in the neighborhood of 5%, whereas the solubility of Cu in the austenitic material was in the neighborhood of 10%. The effect of introducing Cu was to increase the resistance of the material to attack in hydrochloric acid, and a table is given showing the relationship between the Cu content and the loss in weight of the series of alloys investigated in mg./dm.^{2}/day. The author also deals with the effect of Cr and Al on the corrosion of austenitic cast Fe in nitric acid and on the resistance of the material to oxidation at 800° C. Attention is also directed to the effects of Cu and Si on the hardness and the electrical resistivity of these materials OWE(27)

Influence of Phosphorus, Sulphur, Nickel and Chromium on the Growth of Cast Iron. (Der Einfluss von Phosphor, Schwefel, Nickel und Chrom auf das Wachstum des Gusseisens.) O. BAUER & K. SIPP. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 15–23; *Giesseri*, Vol. 17, Oct. 10, 1930, pages 989–995.

Other constituents being held quite constant in each series, the influence of the elements named was studied on a total of 30 compositions. Specimens were heated for 8 periods of 10 hours each at 650° C., and then for 8 more 10 hour periods at 850° C. The irons high in P (0.9–1.3%) gave poorest results in both series. At 650°, the 4 best irons studied were

C	*Si*	*Mn*	*P*	*S*	*Ni*	*Cr*
3.4	1	0.5	0.2	0.3	—	—
3.3	1	0.5	0.5	0.35	—	—
3.0	0.75	0.8	0.2	0.1	1.35	—
3.0	1.75	0.8	0.2	0.1	1.35	0.8, with 1.05–1.15%

growth, while the worst was

C	*Si*	*Mn*	*P*	*S*	*Ni*	
3.3	1.4	0.7	0.2	0.1	0.2	— With 2% at

850° C. the 4 best were

C	*Si*	*Mn*	*P*	*S*	*Ni*	*Cr*	*Growth %*
3.3	0.7	0.7	0.2	0.1	0.3	—	1.9
3.0	0.8	0.8	0.2	0.1	0.5	—	2.7
3.0	0.8	0.8	0.2	0.1	1.0	—	2.2
3.0	0.8	0.8	0.2	0.1	1.4	—	2.8, and

	C	*Si*	*Mn*	*P*	*S*			
the worst	3.0	1.5	0.5	1.2	0.2	—	—	with 6.3%.

The measurements are recorded at various stages of the test for the 30 irons. It is concluded that growth in the primary period, due to carbide decomposition, is hindered by Mn and Cr, aided by Si, P and Ni, with S and C neutral except that very high S retards growth. The second stage of growth is due to exterior conditions, i. e., oxidation. HWG+Ha(27)

The Influence of the Silicon Content and the Cooling Velocity on the Constitution of the Phosphide Eutectic in Cast Iron. (Der Einfluss des Siliziumgehaltes und der Abkühlungsgeschwindigkeit auf die Konstitution des Phosphideutektikums im Gusseisen.) P. BARDENHEUER & M. KÜNKELE. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 22, 1931, pages 417–422.

See *Metals & Alloys*, Vol. 2, Jan. 1931, page 18. Ha(27)

Nickel Addition Affects Bearing Wear Resistance. JAMES BRINN. *Foundry*, Vol. 59, Aug. 15, 1931, pages 40–41.

Alloys used in tests were the regular 80% Cu, 10% Sn and 10% Pb, and alloys which have been derived from these alloys by replacing 0.5, 1, 2 and 3% Sn with the same percentage of Ni. Addition of 2% Ni to an 80% Cu, 10% Sn and 10% Pb alloy prevents segregation of Pb but decreases resistance to wear. Ni addition also causes a tendency in the metal to oxidize both in the crucible and mold. Fine grain structure and greater hardness can be obtained by pouring metal into chill instead of sand molds. The author concludes that improvement in grain structure and Brinell hardness of bearing bronzes lessens wear resistance. VSP(27)

Influence of Small Quantities of Foreign Metals upon the Properties of Refined Zinc. (Einfluss geringer Mengen von Fremdmetallen auf die Eigenschaften von Raffinadezink.) O. BAUER & P. ZUNKER. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVII, 1931, pages 24–34.

See *Metals & Alloys*, Vol. 2, Sept. 1931, page 190. (27)

The Influence of Silicon on Nickel Steel. R. HARRISON. *Iron & Steel Institute, Advance Copy* No. 10, Sept. 1931, 19 pages.

The properties of 4% Ni steels containing 0.4% C, 0.3–0.8% Mn and 0.05–0.87% Si were investigated. Si raises the transformation points found on both heating and cooling. As forged, rolled, normalized or hardened, the Si increased the hardness, but the increase was not marked. In the hardened condition, Si had very little effect on the properties. Si tends to reduce the mass effect, but Mn has a more pronounced influence. Si increases the tendency to temper brittleness. In general, it was found that in the type of steels studied up to 0.87% Si did not have much effect on the mechanical properties. Contains 6 references. JLG(27)

Investigation of the Effects of Impurities on Copper. Part VII. The Effect of Antimony on Copper. Part VIII. The Combined Effect of Antimony and Arsenic on Copper. S. L. ARCHBUTT & W. E. PRYTHERCH. *Journal Institute of Metals*, Vol. 45, No. 1, 1931, page 144 (with discussion); abstracted in *Engineer*, Vol. 151, Apr. 3, 1931, page 374; *Iron Age*, Vol. 127, June 4, 1931, page 1815; discussion in *Engineering*, Vol. 131, Mar. 27, 1931, page 410.

Paper read before the Institute of Metals, Mar. 1931. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 144. LFM+VSP(27)

Influence of Molybdenum and Nickel on Cast Iron. J. CHALLONSONNET. *Iron Age*, Vol. 127, June 4, 1931, page 1901.

Abstract translation of article in *Revue de Métallurgie*, Dec. 1930. Discusses the properties of synthetic and commercial cast Fe as influenced by 0.25 to 0.5% Mo, with and without the addition of 1 to 2% Ni. See also *Metals & Alloys*, Vol. 2, Aug. 1931, page 153. VSP(27)

The Effect of Molybdenum on Medium-Carbon Steel Containing 1 to 2.5 Per Cent of Manganese. G. BURNS (Research Department, Woolwich). *Iron & Steel Institute, Advance Copy* No. 5, Sept. 1931, 16 pages.

The effects of several tenths of a percent Mo on the properties of heat treated steels containing 0.3% C with 1.2% Mn and the same quantity of C with 2.2% Mn were investigated. Cooling curves showed that 0.3% Mo lowered the Ar_1 point in the steel containing 1.2% Mn. The addition of 0.3% Mo did not greatly affect the properties of the normalized steels, but it had a beneficial effect on the quenched and tempered steels. The addition of 0.15–0.25% Mo practically eliminated the tendency to temper-brittleness, and reduced the mass effect. The properties of the Mn-Mo steel treated to give a Brinell hardness of 250 are found to approximate those of a Ni-Cr-Mo steel treated to give the same hardness. Tests on several steels treated to a Brinell hardness of 250 include tensile, torsion, impact and Sankey bend tests. The paper contains several tables giving tensile and impact values for the various steels after various heat treatments. Contains 6 references. JLG(27)

INSTRUMENTS & CONTROLLERS (28)

Heat Supervision of an Electric Gas Purification Plant. (Wärmetechnische Ueberwachung einer elektrischen Gichtgas-Reinigungsanlage.) S. HINRICHS. *Stahl und Eisen*, Vol. 51, June 25, 1931, pages 788–790.

The article describes the central supervision station of the gas purification plant at the Klöckner Works Georgmarienhütte. GN(28)

Investigating Vibration Trouble in the Field. PETER DAVEY. *Iron Age* Vol. 127, Feb. 5, 1931, pages 452–455.

Describes the use of the vibrometer which utilizes the stroboscopic principle for checking both rotary and vibratory motions. It includes a "breaker head" by means of which light flashes may be regulated so that they occur once every revolution. It may be applied to high and low speed machinery. VSP(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Corrosion of Steels at High Temperatures. II, III. (Corrosione degli-acciai a temperatura elevata. II, III.) LUIGI LOSANA. *Industria Chimica*, Vol. 5, Mar. 1930, pages 288–291; May 1930, pages 565–571.

The corrosion of 8 samples of steels containing varying proportions of Ni, Cr, Mn, W, V, Mo, Si, P, S and C was measured between 600° and 1050° C., the presence of air, as well as of exhaust gases from gasoline motors. Results indicate that steels containing W, and Mo resist this corrosion much better than chrome steel (stainless). These steels show higher resistance to exhaust gases in comparison with ordinary steel than they do to air. The effect of Cr and Ni, as well as C, on the resistance of motor valves to corrosion at temperatures up to 1000° has been studied. In steel with 10% Cr, 4–10% Ni improves the resistance slightly, while 10–15% Ni gives a decided improvement. With 10–12% Ni steel, 10–11% Cr gives the best results. C has little effect, except to improve low Ni steels slightly. WHB(29)

On Ni-Cu-Alloys at Low Temperatures. (Ueber Ni-Cu-legierungen in tiefen Temperaturen.) KRUPKOWSKI & DEHAAS. *Zeitschrift für Metallkunde*, Vol. 23, July 1931, page 196.

Briefly refers to some determinations on electric conductivity, thermo-electric force and thermal expansion in dependence on the Ni-content down to temperatures of −258° C. EF(29)

Furnace Scale on Forging Heats. W. E. JOMINY & D. W. MURPHY. *Metal Progress*, Vol. 20, Sept. 1931, pages 48–53.

Paper presents data on scaling of C and alloy steels at forging heats in atmospheres resulting from the combustion of various proportions of air-gas mixture. The gas used was a coke oven-carburetted water gas of the following composition; CO_2, 4.0%; unsaturated hydrocarbons, 8.0%; O_2, 2.0%; CO, 20%; H_2, 45.0%; CH_4, 13.0%; and N_2, 9.0%. The effect of H_2 and CO in preventing scaling and of CO_2 and H_2O in the promotion of scaling are discussed. To reduce materially the scaling experienced when a neutral air-gas mixture is burned (CO, 0.0–0.5%), very large excess of gas is necessary resulting in 14.0% of CO in the products of combustion and to eliminate scale an excess resulting in 16.5% is necessary. Any excess of air on the other side of the neutral mixture results in considerable increase in scale. WLC(29)

The Surface Decarburization of Steel at Heat-Treating Temperatures. W. E. JOMINY. *Engineering Research Bulletin*, No. 18, *Department of Engineering Research*, University of Michigan, Ann Arbor, Mich., March 1931, 51 pages.

The surface decarburization of steel at heat-treating temperatures is influenced by a large number of factors, of which the more important are furnace atmospheres, pressures, temperatures, periods of exposure and scale on the steel. To make any predictions regarding the decarburizing action, the effect of the individual gases that may be present in the furnace atmospheres must be considered in relation to one another. It is often possible to use sufficiently short periods of exposure to minimize the decarburizing effects. These effects obtain in most steels, although steels of certain compositions may decarburize more rapidly than others. (29)

Heat-Resistant and Corrosion-Resistant Steels for Steam Boiler Construction. (Warmfeste und korrosionbeständige Stähle für den Dampfkesselbau.) H. JUNGBLUTH & H. MUELLER. *Krupp'sche Monatshefte*, Vol. 12, July 1931, pages 179–188.

Description of exhaustive tests which were made in the Krupp laboratories to develop heat-resistant and corrosion-resistant steels, especially for the construction of high pressure steam boilers. It was found that Cr-Mo or Cr-Si-Mo steels with about 1% Cr showed the desired qualities to a high degree up to temperatures of 600°–650° C.; another group of Cr-Si-Mo steels with about 6% Cr and 1.5% Si had a somewhat lower permanent strength but they were more resistant to corrosion up to 800° C. The authors, however, believe that, from the test results, the steels of the first class are preferable. The properties of the steels are discussed at great length. Ha(29)

Resistance of Ordinary Steel at High Temperatures. (Sur la résistance à chaud des aciers ordinaires.) LEON GUILLET, JEAN GALIBOURG & MICHEL SAMSOEN. *Comptes Rendus*, Vol. 192, Apr. 15, 1931, pages 861–863.

The authors describe an investigation involving the use of a modified Martin's extensometer designed by them (*Comptes Rendus*, Vol. 188, pages 1205–1208). In the present investigation, a series of boiler steels have been tested, and values for 2 mechanical characteristics of the steels at temperatures of 225°, 325°, 425° and 525°, respectively, are tabulated. The 2 characteristics referred to are known as (1) the limit of instantaneous extension proportional to load (when passing from one load to a higher, observations are made of the instantaneous extensions which, for loads between zero and a certain limiting value, are proportional to the excessive load which has just been applied, but are not proportional to the excessive load if and when loads exceeding this limit have been reached) and (2) the limit of instantaneous extension without a creep in relation to time (after the instantaneous extention has been measured, provided the load exceeds a certain limiting value and is continuously applied to the sample under test, the sample extends continuously with time, but ultimately extension reaches a limit at which it stops). The authors claim that the following generalization has been proved: Properly speaking, a true elastic limit does not exist, even for steels at ordinary temperatures, the apparent permanence of dimensions after a slight load has been applied being an illusion resulting from the imperfect sensitivity of our measuring instruments. WAT(29)

On the Magnetization of Single Crystals of Cobalt at High Temperatures. KOTARO HONDA & HAKAR MASUMOTO. *Science Reports of the Tohoku Imperial University*, Vol. 20, July 1931, pages 323–341.

Measurements of the magnetization of single crystals of Co at temperatures ranging from −190° to +390° C. were made by the ballistic method. The magnetization at ordinary temperatures in the direction of the 0001 axis rises at first rapidly and attains an asymptotic value in a comparatively weak field. As the temperature is raised, the intensity of magnetization in weak fields increases up to 230°, and then decreases. Magnetization in the directions of the 1010 and the 1120 axes at ordinary temperatures is very difficult, so that even in a field of 10,000 gausses the saturation value is not reached. As the temperature is raised, the magnetization in these directions becomes easier up to 300°, but above this temperature, it does not change appreciably. The saturation value of the magnetization of a cobalt crystal at absolute zero has been estimated to be 1446 C. G. S. units. WAT(29)

Higher Pressures and Temperatures as They Affect the Design, Installation and Maintenance of Piping. J. J. HARMAN. *Heating, Piping & Air Conditioning*. Vol. 1, Dec. 1930, page 785–991; Vol. 2, Jan. 1931, pages 20–29; Feb. 1931, pages 106–112.

A series of three articles on the general effect of temperature on the properties of metals used in pressure piping. A safe stress-temperature curve is given for a 0.30% C cast steel, to temperatures of 1000° F. Creep is discussed from a view point of design, installation and maintenance. Many illustrations and diagrams of pipe design are given which illustrate the subject. WAT(29)

Relation Between Temperature and Tensile Strength. E. KIEFT. *Iron Age*, Vol. 126, July 31, 1930, page 282.

Abstract of paper read before the Association of Iron & Steel Electrical Engineers at Buffalo. Knowledge of strength of steel at various temperatures is important in rolling mill analysis. Relation between temperatures and tensile strength of iron and steel.

lb./in.² at Varying Temperatures

	Wrought Iron	Mild Steel		Hard Steel	
Temp. °F.	0.05–0.15%C	0.30%C	0.50%C	0.75%C	1.00%C
2,200	2,250	....	....	.....	.....
2,100	3,500	4,000	....	.....	.....
2,000	4,500	5,000	5,600	6,500	.....
1,900	5,100	5,800	7,300	8,800	13,000
1,800	5,800	6,700	8,800	11,000	17,000
1,700	7,000	8,600	10,700	13,800	23,000
1,600	8,600	10,000	12,500	15,600	31,000
1,400	12,600	14,000	15,500	17,000	.....
1,200	18,000	....	....	.....	.....
1,000	25,000	....	....	.....	.....
Cold (60)	50,000	70,000	85,000	100,000	120,000

VSP(29)

Some short-time high-temperature tension tests. (Quelques résultats d'essais de traction à chaud.) P. HERMAN & R. MOSSOUX. *Congrès International des Mines, de la Métallurgie et la de Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June, 1930, pages 321–326.

Shows sketch of mirror extensometer. Steels for gasoline motor valves were tested at 750° C. The apparent elastic limit at 750° places the Cr, Cr Ni, Cr Co and Cr Ni W valve steels tested in about the same order as their lives in actual service. The sensitivity of the extensometer is not discussed. A steel of about 0.30% C, 11% Cr, 25½% Ni, 11½% W, 2½% Mn, ½ Si showed an apparent elastic limit at 750° C. of 44,000 lbs./in.², tensile strength of 54,000, these being considerably higher than for the other steels tested. Increase in Co content does not improve the high temperature properties of these steels as much as does an increase in Ni. HWG(29)

Flow of Steels at Elevated Temperatures. F. P. COFFIN & T. H. SWISHER. *Preprint, American Society Mechanical Engineers*, June 1931, 7 pages.

Flow tests of steels at elevated temperatures, as carried on in the Research Laboratory of the General Electric Company, are described. Various methods of testing are used. Some are for the purpose of obtaining a mass of information in the shortest possible time, here the rate of flow is measured for a series of successively increased temperatures. Others are designed to furnish more fundamental information regarding the nature of flow, here new specimens are subjected to constant stress at a constant temperature. A third is the constant-extension test where the stress is varied with time to maintain a constant total elongation (elastic plus plastic). The apparatus is described and pictured in some detail. Values for the stress producing 1% flow in 100,000 hours are given at 450° C. for 37 low alloy content Ni, Cr, Mo, V, W steels. Additional values are given in some cases for temperatures 400, 500 and 550° C. Time-elongation and stress-flow rate curves illustrated the results. WAT(29)

Steam Turbine Materials for High Temperatures. R. C. ALLEN. *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 meeting, *American Society for Testing Materials*, pages 550–556, 7 figures.

Past turbines mostly run below 750° F., present standard is around 850° F. and temperatures to 1000° F. are being considered. The high temperature end of a turbine must be designed to allow for creep, 0.01% per year being set as the limit, in planning for a life of 15 to 25 years. A 50" diameter cylinder, creeping at that rate, will increase 0.075" in 15 years, increasing clearance 75% and decreasing efficiency 7%. Tangential stress in the inner bore is 11,000 lbs./in.² Working stress in turbine blades may reach 20,000 lbs./in.² Cylinders are usually 0.30–0.35% carbon steel castings when operation is at 800° F. For 900° F. with tangential bore stress of nearly 7000 lbs./in.² a 0.30 C, 2.10 Ni, 0.80 Cr, 0.30 MO steel is used. Huge studs are required for such a cylinder, each one carrying 680,000 lb. load. Threads are copper or chromium plated to prevent galling. To prevent galling under the heads, case hardened or nitrided washers are used. The studs are 0.10 C, 12% Cr (Ni 0.60% maximum), quenched from 1700° F., drawn at 1200° F. It may be necessary to warm the studs at the same time that cylinder and spindle are warmed up in starting. The turbine spindle for 800° F., 3600 r. p. m. is 0.40 C steel, peripheral stress about 9700 lbs./in.² For higher temperatures a 0.38 C, 0.50 Cr, 2.50 Ni, 0.30 Mo steel is used. Turbine blades are commonly made of a stainless steel, same composition as given above for studs. This is the best available material. It can be stressed (0.01% creep per year) to 18,000 lbs./in.² at 875° F. or 5500 lbs./in.² at 1000° F. Better bolt steels and alloy steels for castings to serve at elevated temperatures are urgently needed. HWG(29)

The Wrought Austenitic Alloys (at High Temperatures). R. H. ABORN & E. C. BAIN. *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931 meeting, *American Society for Testing Materials*, pages 322–346; 4 figures, 10 tables, 53 references.

Clear statement of factors affecting corrosion resistance at room temperature and mechanical properties at high temperatures of wrought austenitic alloys varying from 0.05 to 0.20% C, 0.30 to 2¹/₂₅% Si, 7 to 30% Ni and 16 to 30% Cr. High temperature uses depend on the fundamental fact that austenite, γ-iron, has greater resistance to change of shape than has ferrite, α-iron, probably because of higher recrystallization temperature and lower recrystallization velocity. Addition of elements such as Cr, W and Mo to austenite aids in this. The austenitic structure may be imparted either by Ni or by Mn. All the high temperature data presented relate to that produced by Ni. Detailed data are tabulated. These alloys have but ⅓ the thermal conductivity of iron which may lead to local overheating. They have a high thermal expa ion, which may lead to buckling. Intelligent application is necessary. Cr tends to stabilize α Fe, Ni and C to stabilize γ-iron. Some combinations not in true equilibrium tend to be sluggish and remain in the γ-state. Cold work tends toward establishment of true equilibrium. Separation of (*a*) high temperature ferrite, (*b*) low temperature ferrite (*c*) carbide may occur in some compositions at some temperatures. These matters are shown by diagrams and discussed in relation to embrittlement of 18–8, add to variations in its composition. Intercrystalline weakness resulting from long sojourn at 1165–1380° F. is lessened by addition of W. Carbide precipitation is accompanied by depletion of Cr in the surrounding territory, since Cr goes out of solution to enter the carbide. Until this inhomogeneity is repaired by diffusion through heating to a sufficiently high temperature the depleted areas do not contain the proper amount of Cr. The depleted areas are susceptible to corrosion, including that by furnace gases. Carbide precipitation near welds has to be remedied by heat-treatment. Straight 18–8 has shown fine service in many applications under severe conditions to 1110° F. and modern low carbon material is usually applicable to 1250° F. In some cases carbide precipitation has been reported after very long exposure to 850° F. Much detailed data on short time tests, creep tests, mechanical properties at room temperature after prolonged heating, etc., are given in tables too extensive for abstracing. The article is of interest in many ways aside from its high temperature data. HWG(29)

Flow of Steel at High Temperatures. F. H. NORTON. *Preprint, American Society of Mechanical Engineers*, Oct. 1930, 5 pages.

Presented at the National Petroleum meeting of the American Society of Mechanical Engineers in Tulsa, Okla., October 6–8, 1930. In general there are three types of flow. The first is turbulent flow where the velocity is proportional to the square root of the stress. This type of flow is encountered in gases, and liquids of low viscosity. The second type is viscous flow where the velocity is proportional to the stress. The third type is plastic flow where no simple relation has previously been found to exist between stress and flow rate. It is this last type of flow that is of interest in dealing with steel at high temperatures. In general all solids are composed of rigid particles held together by a more viscous medium. In a single crystal, these particles are molecules held together by attractive forces; in a mass of wet clay, the particles are crystals of clay substance, often of colloidal size, held together by a film of water; and in steel, the particles may be molecules in a crystal, or the crystals themselves held in a comparatively viscous intergrain material. When a material of this kind is deformed, the friction between the particles must be overcome. The thicker and more fluid the interparticle film, the less will be the friction. The apparatus used was the same as was described in Norton's book (Creep of Steels at High Temperatures, McGraw-Hill Book Co., New York City, $3.00). Two steels were investigated, 0.05% C, 18–8 Cr-Ni, and 0.59% C, 28–23 Cr-Ni. The temperature and duration of tests were as follows: 650° F., 4100 hrs.; 1000° F., 4200 hrs. and 1350° F., 2300 hrs. It would appear from the limited data that all steels at temperatures above 650° F. have the same characteristics which may be expressed by: Rate of Flow = K (Stress)^5
That is, if the stress is doubled the rate of flow increases 32 times. There is no indication of a limit below which there will be no creep. Work is now in progress on a number of other plastic and viscous materials in order to correlate their flow characteristics. The preliminary results indicate that the fifth power relation holds for materials as widely different as steel and soft clay. The possibility is suggested of a new regime of flow at low rates, logically connected to viscous flow and turbulent flow at the higher rates. WAT(29)

Influence of Grain Size on the Properties and Corrosion Resistance of the 18–8 Iron-Chromium-Nickel Alloy for Elevated Temperature Service. H. D. NEWELL. *Preprint, American Society for Steel Treating*, Sept. 1931, 61 pages.

Preliminary experiments showing the influence of heat treatment on grain size, were made on 0.08% carbon, cold drawn 18–8 alloy and on 0.056% carbon, hot rolled 18–8 alloy. Data are presented on the short time ultimate strength and ductility of 0.05 and 0.14% carbon 18–8 alloy in conditions representing several grain sizes. These data cover both 1 and 150 hours heating in the range 800° to 1700° F. A discussion of the test results is given with reference to the effect of grain size on creep as found by other investigators. The grain size of the alloys is shown by photomicrographs for conditions representing hot-rolled and quenched from 1900, 2100 and 2300° F. The effect of reheating at 1200° F. on corrosion resistance, is shown by tests in dilute sulphuric acid and by susceptibility to attack in the Strauss solution. The distribution of carbides, precipitation by heating at 1200° F. is shown in photomicrographs of 0.05 and 0.14% carbon alloy in the hot-rolled condition and after quenching from 1900, 2100 and 2300° F. The following conclusions have been drawn from the results of this investigation: The ductility of both 0.05 and 0.14% carbon, 18–8 alloy, on rupture at elevated temperatures is greatly affected by the grain size of the metal. Fine-grained alloys show much more ductility than do coarse-grained ones at temperatures in the approximate range 1100° to 1700° F. The short time ultimate strength is also affected by grain size, but this is not considered of importance as other investigators have shown creep to be somewhat superior in coarse-grained 18–8 alloy at temperatures of 1180° F. The corrosion resistance of 0.05% carbon alloy is much less impaired by reheating within the fine carbide precipitation range than is the 0.14% carbon alloy. Susceptibility to intergranular attack after reheating is influenced by both carbon content and grain size. Fine-grained low carbon alloy is not susceptible to intergranular corrosion on reheating, but may become so if the grain size is sufficiently large. This is due to the amount or extent of grain boundaries available to the precipitated carbides. The higher carbon alloy (0.14% C) is susceptible even in a fine-grained condition by reason of the greater amount of carbon available for precipitation. Low carbon alloy having a fine-grain size is to be preferred for elevated temperature service involving corrosion because of its greater ductility and non-susceptibility to intergranular attack. Restriction of the carbon content and of the grain size of the 18–8 alloy produces the most satisfactory condition for ductility at elevated temperatures and for maintenance of corrosion resistance properties at or after heating to a temperature sufficient for carbide precipitation. WAT(29)

The Behavior of Steel at High Temperatures. V. B. HARLEY MASON. *Engineer*, Vol. 152, July 31, 1931, pages 115.

No new data. A discussion of the creep test from the early developments to the present. Dickinson's early work is discussed and compared with Hatfield's "time-yield." The work of Lea, Batson and Tapsell and Norton is also reviewed. The disadvantage of the long time required to make satisfactory creep tests is emphasized. Hatfield's "time-yield" test for this reason, according to the author, has many advantages. The article is entirely a résumé of the developments, advantages and disadvantages of the creep test. WAT(29)

Program for Work of the French Committee for Study of the Resistance of Metals at High Temperatures. (Mise en route des travaux du Comité pour l'etude de la resistance des Métaux à chaud.) J. GALIBOURG. *Revue de Métallurgie*, Vol. 28, May 1931, page 259.

At the suggestion of the French Association for Testing Materials, this committee has been formed, representing 12 steel producers, 10 fabricators and 12 users. The work of the committee will be the exclusive property of those supporting the work. The program includes the formation of subcommittees on definitions and terminology; on technique of testing methods, to compare tests on wires and bars by tension, torsional creep, the method of oscillations, etc.; on apparatus for temperature control, and measurement of creep; on summarizing the literature; on procurement of materials to be tested; on survey of metals used and properties needed; on forgeability of metals. HWG(29)

Strength of Materials Subjected to Shear at High Temperatures. *Preprint, American Society Mechanical Engineers*, June 1931, 13 pages.

The paper relates to an experimental program which is basically fundamental in the study of creep. Uniformly pure shear is produced in a thin tubular specimen submitted to twist, whereas the usual method employs a solid bar in tension. The material tested was an 0.34% carbon seamless steel tubing. The paper includes physical properties in torsion and tension at room temperature, results on the effect of different rates of loading on "short-time" tests on the modulus of elasticity and ultimate strength in shear at temperatures up to 500° C, "long-time" tests in shear at 400° and 500° C. An accelerated method for making creep tests is described. Building vibrations and jars increase the rate of creep, although not in all cases. A mathematical formula is derived whereby the effect of temperature fluctuations may be calculated for the rate of creep in shear. The apparatus and specimen used are described in detail. The results are illustrated with numerous curves. WAT(29)

Impact Characteristics of Steel Rails at Low Temperatures. J. F. CUNNINGHAM & J. GILCHRIST. *Preprint American Society for Steel Treating*, Sept. 1931, 13 pages.

In the specimens of rails tested, and in 0.92% C, 0.42% C steels and open-hearth iron, there is a gradual decrease in impact resistance down to temperatures of −28° to −29° C. (−18° to −20° F.). From this point the resistance to impact has reversals at fairly definite temperatures. Uncertain results may be expected to shock resistance below a temperature of −29° C. (−20° F.). The only material tested and showing these reversals is the 0.10% C rivet steel which does not suffer from reduced temperatures until −40° F. is reached. Ferrite grains from small to medium sizes will resist the lower temperature effects better than larger grains. Medium grains of medium pearlite with a slight excess of ferrite are more resistant to impact at low temperatures than either coarse or fine pearlite. Any excessive amount of free ferrite at grain boundaries is especially susceptible to impact at low temperatures. The following conclusions are submitted for consideration. The orientation of the pearlite lamellae in relation to the direction of the impact stress will be found to have a considerable effect upon resultant values. Different components (cementite, ferrite, etc.) having different coefficients of contraction due to lowering of temperature, may cause minute strains in the structure which reach a maximum near a temperature of −28° to −29° C. (−18° to −20° F.). These coefficients may be constant down to −18° to −20° F. but not below that temperature. There is a vital need for more information concerning the behavior of metals at low temperatures. For the sake of economy the factors of safety in design must be lowered, and with airplane, automobile and railroad transportation demanding the utmost resistance in the severe winter in many parts of the continent, there is an important field of investigation in the low temperature, as well as the high temperature field. WAT(29)

Values and Boiler Fittings for 1900 Lb. and 900°. BRUNO BELOHLAVEK & ARTHUR J. HERSCHMANN. *Power*, Vol. 73, June 30, 1931, pages 1028–1031.

The authors are, engineer in charge and U. S. representative, respectively, of the Vitkovice Steel Works, Czechoslovakia. The article describes the values and boiler fittings for the steam pressure indicated, from a viewpoint of design rather than the material used. The analysis of steel was not given other than "Vitko" S. O. having a tensile strength of 78,000–92,000 lbs./in.^{2} and being rustless. Diagrams of the various valves and fittings are given. WAT(29)

Variations of the Resilience of Steel as a Function of the Temperature. J. DESSENT. *Revue Universal des Mines*, Series 8, Vol. 5, Feb. 1931, pages 97–99.

In hypoeutectoid carbon steels, the resilience increases with the temperature and reaches a maximum at or near ordinary temperatures, depending upon the carbon content. It then decreases to a minimum in the vicinity of 500° and then increases again very rapidly. The variation of the resilience with temperature is greater when the carbon content is lower. Pearlite and ferrite behave differently on heating and the resilience of a steel is the resultant of their change and depends on the proportion of these constituents present. In hypoeutectoid steels the resilience varies only slightly as a function of the temperature. WAT(29)

Zinc Alloys for High and Low Temperature Service. H. A. ANDERSON. *Preprint* for A. S. T. M.-A. S. M. E. Joint Research Committee Symposium on Effect of Temperature on Properties of Metals, June 1931, meeting *American Society for Testing Materials*, pages 179–197, 14 figures, 32 references.

Since zinc melts at 787° F., its alloys are not ordinarily considered in discussions of high temperature properties. Zinc and many of its alloys are weaker and more brittle below room temperature. The strength also falls at higher temperatures.—Ductility usually first falls, then rises to a maximum about 150° C., hence zinc is rolled at about that temperature. Zinc base die castings made from impure zinc or of improper compositions grow warp and become brittle in moist air at elevated temperatures. The present die casting alloy, made from 99.99% pure zinc and containing 4% Al, 3% Cu and 0.1% Mg is, however, very stable. Hitherto unpublished data on this alloy are plotted, the tensile strength falling in almost a straight line from about 50,000 lbs./in.^{2} at 32° F. to a bit under 6000 at 500° F. Elongation rises from 1½% to 35%. HWG(29)

Time Deformation—the Nature of "Creep Tests." G. R. BROPHY. *Metal Progress*, Vol. 20, Aug. 1931, pages 54–57.

Advance information on a paper to be presented before the American Society for Steel Treating Convention in Boston, September 1931. The purpose of the present paper is to present a study of the fundamentals of deformation and to suggest a possible short time method for consideration. The apparatus used and methods followed are essentially those described by Prof. Albert Sauveur in the Campbell Memorial Lecture before the American Society for Steel Treating in 1930. The type of test is essentially a torsional-creep test and temperatures between room and 485° C. were investigated. It was found, among the steels investigated, that three types could be recognized as having load-deformation curves of different characteristics. Type (1) has a stepped diagram up to some temperature, and above that temperature, a smooth curve. As the temperature of testing increases, the number of steps decreases, but each step increases in magnitude and, of course, the so-called plastic portion of the curve is displaced downward. This type of action is characteristic of annealed simple low carbon steel. Type (2) is characteristic of quenched, and quenched and drawn simple steels and of some alloy steels. Smooth deformation curves are obtained at room temperature and at higher temperatures, but at intermediate temperatures steps are found as before. It was found that those steels which show a stepped load-deformation diagram (types 1 and 2) lose the steps at some elevated temperature and that this temperature varies from 375° C. to 475° C. for the steels tested. The (3) type shows smooth load-deformation curves from room temperature up. As stated by Sauveur, this curve is characteristic of austenitic steels. WLC + WAT(29)

Cast Alloys for High Temperature Service. D. HANSON. *Foundry Trade Journal*, Vol. 44, June 4, 1931, pages 387–390.

The article is entirely a general discussion and review of the subject. Mechanical strength and chemical resistivity are the two chief factors to be considered in selecting materials for high temperature service. The type of service to which the material is to be subjected must be considered in the selection of the material to meet that service. The work of Pfeil on oxidation is discussed. Thermal expansion must be considered for in many cases it is the oxide layer that increases the chemical resistivity and this protective coating must be kept intact. Most heat resisting alloys are of the solid solution type. The futility of accelerated tests is discussed. In determining the strength characteristics actual service must be duplicated as nearly as possible. Castings in many cases are more serviceable for elevated temperature service than wrought materials. The author discusses the "available alloys" among which commercial cast irons, alloyed cast irons, alloys of copper and alloys of nickel-chromium-iron are included. WAT+OWE(29)

Heat Resisting Steels. H. N. Bassett. *Industrial Chemist*, Vol. 7, Aug. 1931, pages 318–319.

Cast iron can be used where temperatures do not exceed about 600° C. A 13% Cr steel may be used up to 800° C. with satisfaction. The latter, however, is not suitable for the valves of internal-combustion engines and for such purposes an alloy is used which contains 8 to 9% Cr and some 3 to 3½% Si. In Diesel engines and high-powered internal-combustion engines, Ni, Cr, W steels are employed because they have higher mechanical properties. Thus ERA/ATV steel (a Ni-Cr-W alloy) has a tensile strength of about 16 tons/in.² at 900° C. The remainder of this article discusses the work done by Bullens, Hadfield and Matthews to which references are made. RAW(29)

The Determination of Corrosion Resistance of Metallic Materials at Elevated Temperatures. (Ueber die Bestimmung der Korrosionsbeständigkeit metallischer Werkstoffe bei hohen Temperaturen.) J. Fritz & F. Borneffeld. *Krupp'sche Monatshefte*, Vol. 12, Aug.-Sept. 1931, pages 237–241.

The method used by Krupp determines the loss of metal under heating of from 120 to 240 hrs. at 500–1300° C. The furnace and procedure used is described and directions for the proper evaluation of the test results are given. Ha(29)

The Effect of Low Temperature on the Shock-Resisting Properties of New Wrought-Iron Chain. H. J. Gough & A. J. Murphy. *Proceedings Institution of Mechanical Engineers*, British, No. 5, Dec. 1930, pages 1159–1223.

The general results of the investigation may be summarized as follows: Best quality chain does not develop any brittleness in the absence of notches within the temperature range investigated, 17° to −78° C. The notched bar valve of best quality chain iron decreases but slightly as the temperature falls from 200° C. to air temperature. Notch brittleness commences at air temperatures and becomes increasingly evident as the temperature is further reduced, the rate of decrease of energy with falling temperature is greatest at a temperature intermediate between air temperature and 0° C. The shock-absorbing value of new ¾ inch wrought-iron chain, of high-quality material and manufacture, falls only slightly as the temperature of test is lowered from air temperature to −30° C. It falls at a very rapid rate as the temperature is further decreased to −78° C. This temperature brittleness is in most cases attributable to the welded scarf of the link, the end of which acts as an effective notch and causes failure on account of the notch brittleness to which chain iron has been shown to be subject. In several cases, however, evidence has been obtained which shows that a defective link (imperfect weld, accidental surface injury, etc.) may behave in a brittle manner at much higher temperatures (−10° C. in present tests). The brittleness associated with wrought iron at moderately low temperatures is not a persisting effect and disappears when normal temperatures are again attained. WAT(29)

Some Developments in High-Temperature Alloys in the Nickel–Cobalt–Iron System. C. R. Austin & G. P. Halliwell. *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 430, Sept. 1931, 21 pages.

Small melts of Ni-Co-Fe (Konel) alloys were made in an induction furnace, forged to bars and the short-time tensile properties at 600° C. obtained. Most of the alloys contained Ti, usually 2.5%. Samples were tested after annealing and after aging at 650° C. High proportional limit values shown by some of the alloys indicate the probability of high creep limits. Proportional limits at 600° C. between 50,000 and 70,000 lb./in.² were observed. An alloy containing 46.1% Ni, 24.86% Co, 7.02% Fe, 2.19% Ti and 18.74% Cr had the following properties at 600° C.: 57,000 lb./in.² proportional limit, 21% elongation and 21% reduction of area. This is markedly superior to the properties of a 70–30 Ni-Cr alloy. Many of the alloys were age hardenable. Although Ti appeared to be a necessary constituent of age-hardenable alloys, the compound responsible for the phenomenon was not determined. Data obtained by a special bend test for temperatures up to 800° C. are given. Contains 8 references. JLG(29)

An Instable State Found in an Fe-Ni-Alloy Which Cannot Be Eliminated at Even 1000° C. (Beispiel eines instabilen Zustandes in Legierungen, der sich auch bei 1000° C. nicht zur Reaktion bringen lässt. Fe-Ni-Legierungen.) L. Anastasiadis & W. Guertler. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, pages 189–190.

The paper presented before the Deutsche Gesellschaft für Metallkunde, Berlin, 1930 pertains to a phenomenon met with in pure Fe-Ni alloys: the impossibility of eliminating the super-cooling and super-heating of the $(\alpha + \beta)$ γ-transformation which was checked by electric resistance measurements. The instable state cannot be eliminated at even 1000° C. EF(29)

Temperature Coefficient of the Modulus of Rigidity of Aircraft Instrument Diaphragm and Spring Materials. W. G. Brombacher & E. R. Melton. *Review of Scientific Instruments*, Vol. 1, Nov. 1930, page 697.

Abstract of the Report No. 358, National Advisory Committee for Aeronautics, 1930. Al, duralumin, Monel Metal, brass, coin silver, Ni-Cu-Zn alloy, 3 carbon steels and 3 alloy steels (composition not stated in abstract). Effects of heat treatment on the temperature coefficient was determined for some of the materials. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 51. Ha(29)

Influence of Heat Treatment on the Electric Conductivity of Carbon Steels. (Einfluss der Wärmebehandlung auf die Leitfähigkeit von Kohlenstoffstählen.) M. Boussat. *Recherches et Inventions*, Vol. 12, Feb. 1931, pages 33–49; *Chemisches Zentralblatt*, Vol. 102, Apr. 29, 1931, pages 2663–2664.

The measuring methods to determine the electrical conductivity are described and possible errors discussed. Tests on steels with 0.10, 0.42 and 0.61% C show that electric conductivity and the temperature coefficient decrease with increasing content of C. It is further stated that between 0 and 200° C., the conductivity changes linearly with the temperature. Quenching increases the resistance of C steels while subsequent tempering reduces the resistance again to the resistance before hardening. Ha(29)

The Behavior of Various Light Metals at Low Temperatures. (Über das Verhalten verschiedener Leichtmetalle in der Kälte.) Franz Bollenrath & Joan Nemes. *Metallwirtschaft*, Vol. 10, July 31, 1931, pages 609–613; Aug. 7, 1931, pages 625–630.

Contains 7 references. The modulus of elasticity, modulus of deformation, elastic limit at 0.01 and 0.03% permanent elongation, yield point, tensile strength, elongation and reduction of area in static tension tests, and the specific impact energy, elongation and reduction of area in dynamic tensile tests were determined for 7 Al forging alloys and 2 Mg forging alloys in the range of +80 to −190° C. A special apparatus was used with ice, ice-salt mixtures, solid CO_2 and acetone and liquid air as cooling media. The static tensile properties of all alloys examined rise considerably with lowering temperature, while the elongation and reduction do not change as much. The Mg alloys become very brittle at low temperatures. Silumin and Lautal behave differently from the other Al alloys. The increase in tensile strength at low temperatures is accompanied by a drop in yield point and elastic limit. In the dynamic tests the specific impact energy is highest at moderately low temperatures for most of the alloys, while the elongation is practically constant except with the Mg alloys. Lowering of the temperature does not have as much effect on the dynamic properties as on the static properties and the Mg alloys are not as brittle in the dynamic tests. The results of the tests are given in tabular and graphic form. The conclusion reached is that all the alloys tested can be used at temperatures down to −190° C. CEM(29)

Possible Resistance Anomalies at Low Temperatures. (Sur des anomalies de la résistance aux basses températures.) S. Choubine. *Comptes Rendus*, Vol. 192, Apr. 27, 1931, pages 1020.

An anomalous low-temperature conductivity is to be expected in the case of metals having a number of conductivity-electron pairs, providing the smallest energy of the second zone of the electronic moment space is larger than the highest energy of the first zone. On the basis of Fermi's repartition function, there must be zero resistance in the above metals, even at temperatures above zero absolute, until T reaches a certain value at which the resistance becomes normal. The connection between this abnormal resistance and supraconductivity is discussed. WAT(29)

Recent Metallurgical Research in Relation to Marine Engineering. S. L. Archbutt. *Transactions Institute Marine Engineers*, Vol. 42, 1930, pages 295–346.

The limiting creep stress should be considered for design purposes at elevated temperatures. The nature of the atmosphere seems to influence the rate of creep and the mode of deformation. Intercrystalline fracture was found in some creep tests. A graph showing the relation between temperature, tensile strength, limiting creep stress and limit of proportionality for 0.17% C steel is given. Higher pressures and degrees of super-heat require a material superior to C steel. Creep characteristics are given for various alloys. Ni-Cr alloys and their derivatives are most suitable for temperature ranges of 600–1000° C. Limiting creep stress at the highest temperature increases with increasing Cr content. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 1. WHB(29)

The Oxidation of Some Copper Alloys. John Stanley Dunn (British Non-Ferrous Metals Research Association). *Institute of Metals, Advance Copy* No. 567, Sept. 1931, 24 pages.

The oxidation of Cu-Zn alloys containing as much as 40% Zn was studied. In a pure metal, the rate of oxidation at elevated temperatures is defined by the equation $W^2 = Kt$, where W is the weight of O_2 absorbed, K a constant and t the time. This equation would be expected to hold for some solid solutions. Experimental data proved that it holds for alloys containing from 0 to 12 and from 20 to 40% Zn. The high Zn alloys are oxidized at about 1/8 the rate of the high Cu alloys. The alloys containing less than 80% Cu all oxidize at about the same rate, and give rise to a coating that is almost pure ZnO. Those with more than 86% Cu oxidize at the same rate, and the oxide formed contains the metals in the same ratio as the original alloy. The oxidation of alloys between these 2 fields cannot be expressed by a simple equation. Cl compounds accelerate the rate of oxidation. Small quantities of As and Ni are without influence on the rate of oxidation, but even 0.1% Al has a protective effect. An alloy containing 1.9% Al was almost immune to oxidation at temperatures up to 800° C. Three Cu-Si alloys were studied. As much as 4.58% Si had little effect on the oxidation. Contains 10 references. JLG(29)

LEACHING (30)

Note on the Extraction of Copper from Oxidized Ores by Cyanide Solution. E. T. Dunstan. *Journal of the Chemical, Metallurgical & Mining Society of South Africa*, Vol. 31, May, 1931, page 294.

Discussion of the article abstracted in *Metals & Alloys*, Vol. 2, Aug. 1931, page 155. AHE(30)

The Recovery of Gold and Silver from the Ore of the Gem Lake Mine, East Central Manitoba. A. K. Anderson. *Canada Department of Mines, Mines Branch Report* No. 720, 1931, pages 58–64.

This quartz ore contained 3.5 oz. Au and 0.35 oz. Ag/t. with no As, Sb, Bi or Cu. Best recoveries were obtained by cyanidation and amalgamation, 98.5% of the Au and 97.3% of the Ag. Results are given of amalgamation, cyanidation and concentration alone and in combination. AHE(30)

The Recovery of Gold from the Ore of the Belledat-Goudreau Mine, Goudreau, Ontario. A. K. Anderson. *Canada Department of Mines, Mines Branch Report* 720, 1931, pages 71–81.

The ore consisted of quartz gangue carrying small amounts of iron sulphides and graphite and little PbS. It assayed Au 1.92 and Ag 0.82 oz./t. C is responsible for low recoveries by cyanidation. Amalgamation recovers 80% of the Au; followed by concentration a total recovery of 98.9% is obtained. In continuous operation, graphite coats the plates prohibitively. Floating an alkaline pulp with pine oil removes the graphite in a concentrate containing 22.56 oz. Au and 25.2 oz. Ag/t. This could be smelted. The tailing was easily cyanided to give 99% recovery of Au, a total of 98.9% by the 2 steps. AHE(30)

Report on the Treatment of Mixed (Bulk) Concentrate from Base Metal Sulphide Ore. W. E. Harris, R. J. Traill & H. C. Mabee. *Canada Department of Mines, Mines Branch Report* No. 720, 1931, pages 192–199.

A bulk concentrate analyzing Zn 29.89%, Cu 5.53%, Pb 3.44%, C 4.65%, Fe 19.39%, Au 0.16 oz. per ton and Ag 7.4 oz. per ton was roasted and leached. The liquors were neutralized to remove Fe, filtered, purified and electrolyzed. The residues were retreated by the Waelz process for volatilization of Zn and Pb. The residue from this step was a smelter product for the recovery of Cu, Ag and Au. Detailed data of each step are given. AHE(30)

REDUCTION METALLURGY (31)

New Facts on Blast Furnace Coke. (Neue Erkenntnisse zur Beurteilung von Hochofenskoks.) A. Killing. *Stahl und Eisen*, Vol. 51, July 16, 1931, pages 901–908.

Report 120 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. By tests running over several months, it was found that the use of coke made from finely ground coal (90% had a grain size of 0 to 3 mm.) decreases the fuel consumption in producing Thomas pig iron. This coke possessed a high porosity and it is assumed that any type of blast furnace coke should have a high porosity, provided it also has proper strength. GN(31)

Composition of Gas at Different Zones in the Blast Furnace, and the Theory of Mathesius. (La composition des gaz aux différentes zones du haut fourneau et la théorie de Mathésius.) A. Lefebvre. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 25–28.

Samples of gas were taken a few centimeters from the wall of a 250-ton blast furnace at 4 different heights. Two samples at each station were analyzed and the results averaged. The total $CO + CO_2$ remained practically constant but the ratio CO_2: CO increased steadily from tuyères to throat. A constant amount of 0.40% O_2 was found in all samples. HWG(31)

Modern American Metallurgical Practice. W. D. Jones. *Bulletin Institution of Mining & Metallurgy* No. 322, July 1931, 9 pages.

Brief notes are given on the East Helena, Mont., plant of the Anaconda Copper Mining Co., the Kellogg, Id., plant of the Bunker Hill and Sullivan Co., the Garfield, Utah and Omaha, Neb., plants of the American Smelting and Refining Co., and the Tooele, Utah, plant of the International Smelting Co. AHE(31)

Sintering Minnesota Iron Ore at the Evergreen Plant. A. H. Hubbell. *Engineering & Mining Journal*, Vol. 132, Sept. 28, 1931, pages 244–247.

Technical details incidental to the design and operation of the largest sintering machine in the world, at Crosby, Minn., are given. The flowsheet for the plant is shown. WHB(31)

The Reduction Characteristic of Some Iron Ores. (Reduktionscharakteristik einiger Eisenerze.) J. KLARDING. *Archiv für Eisenhüttenwesen*, Vol. 5, Sept. 1931, pages 129–138.

The reduction of chemically pure iron oxide, various magnetites, siderites, minettes, limonites, purple ore and other iron ores was studied. After heating the finely powdered ores to 900° C. in vacuum, measured volumes of CO gradually reacted with the ores at that temperature. After the equilibrium had been established, the CO_2 content of the gas determined and the Fe-O content of the residue was calculated. The results were plotted in O_2 concentration curves in dependence on the CO_2 content of the gases after the test. In comparing these curves with the reduction curve of pure Fe_2O_3, conclusions can be reached as to the type and quantity of the impurities of the ores. Since the iron oxides form slags with the gangue present, the equilibrium lines of the ores must, of necessity, deviate from the equilibrium curve of the pure iron oxide. In relating the amount of the reduced Fe to the total Fe content of the ore, conclusions can be drawn as to the reduction capacity of the ores. The reduction curves show that the effect of the admixtures upon the reduction of the oxides of the ore is in part annulled. This finding will probably become of importance in the theory of burdening. The physico-chemical investigation of the O_2-reduction was completed by microscopic examinations. Such examination shows that, during the progress of reduction, new compounds or solid solutions are formed in solid state that can be studied qualitatively and quantitatively. GN(31)

Suggested Improvements in Fire Refining of Copper. H. H. ALEXANDER. *Engineering & Mining World*, Vol. 2, May 1931, pages 287–290.

See *Metals & Alloys*, Vol. 2, July 1931, page 138. (31)

The New Greenawaldt Sintering Plant at Kladno. (Die neue Greenawaldt-Sinteranlage in Kladno.) E. BAUMGARTNER. *Stahl und Eisen*, Vol. 51, Aug. 13, 1931, pages 1017–1021.

After dealing with the reasons for the installation of a Greenawaldt sintering plant at the Kladno iron works of the Prager Eisen-Industrie-Gesellschaft, the plant is described in detail and the practical results on capacity and costs are considered. GN(31)

The Flotation of Gold Ore. JOHN AGNEW. *Canadian Mining Journal*, Vol. 52, Aug. 1931, pages 710–711.

A description of the plant of Lake View and Star, Ltd., at Kalgoorlie, W. A. A flowsheet is included. WHB(31)

Retaining Dust in the Blast Furnace by Means of the Eichenberg Method. (Zurückhaltung des Gichtstaubs im Hochofen nach dem Eichenberg-Verfahren.) P. GEIMER, A. WAPENHEUSCH & A. SPONHEUER. *Stahl und Eisen*, Vol. 51, Aug. 27, 1931, pages 1073–1077.

The Eichenberg method injects gas and water through nozzles arranged around the throat of the blast furnace. By this method, the dust cannot escape and is deposited upon the burden. The gas temperature and its velocity is decreased through the evaporation of the water, thus also decreasing the amount of dust near the throat. Tests at the Hagen Blast Furnace Plant of the Klöckner Works indicate that it is not necessary to inject gas; however, the arrangement and the shape of the nozzles is of extreme importance. The amount of dust in the escaping gas could be decreased by 50% without affecting the operation of the furnace and the quality of the pig iron and the coke consumption unfavorably. Certain relations were found between the composition of the burden, the amount of dust and the effect of the Eichenberg method upon the fine dust content of the raw gas. GN(31)

Some Comments on the Height of Blast Furnaces. (Considérations sur la hauter des hauts-fourneaux.) E. COTEL. *Revue de Métallurgie*, Vol. 28, July 1931, pages 375–378.

The contemporary literature on blast furnace construction does not give a single fully justified reason for the necessity of an excessive height of the furnace. The increase of production can be controlled by the increase of the hearth diameter. The present height of the stack apparently does not bring any advantages but introduces many inconveniences caused by the depth of the burden and crushing of coke. Much information is available at present, both from theoretical considerations and furnace study, showing that the usual vertical dimensions of the blast furnaces can be reduced very considerably with beneficial results. JDG(31)

On the Reduction of Fe_2O_3 and FeO in Vacuum by Solid Carbon. (Ueber den Sauerstoffabbau des Eisenoxyds und des Eisenoxyduls mit festem Kohlenstoff im Vakuum.) W. BANKLOH & R. DURRER. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 455–460; *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 644–645.

Two conditions must be fulfilled in reducing iron oxides with solid C: (1) the mixture of reaction should not come in contact with air (O) since, in that case, CO is formed which is much more active than solid C; (2) the gases of reaction must be carried away as quickly as possible. In order to guarantee these 2 factors, the experiments were made in vacuum. Acheson and Bohemian graphite were used; other types could not be used because they always contained gases. In determining the O content of the reduced mixtures, the degree of reduction is established. Since previous investigators did not consider the phenomena of diffusion, this problem was particularly emphasized in this investigation. It is actually shown that the reduction of iron oxides by solid C is a simple reaction of diffusion, provided that the temperature of reaction is above 700° C. The formation of metallic iron starts at 700° C. Whereas FeO shows practically no reduction below 700° C. Fe_2O_3 reacts at still lower temperatures, down to 300°C., but no metallic iron is formed. It is possible that, in reducing Fe_2O_3 at the temperature range between 300 and 700° C., only Fe_3O_4 is formed up to a certain temperature and that above this temperature only FeO is formed. The Bohemian graphite reacted more readily than the Acheson graphite. GN(31)

Progress in Large Blast Furnace Construction. (Progrès techniques réalisés dans la construction des hauts fourneaux a grande production.) M. DERCLAYE. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th Session, Liege, June 1930, pages 29–48.

Includes discussion. Description and 14 illustrations of blast furnace details and accessories. HWG(31)

The Problem of Ore Dust Entrained by the Gases at the Throat of a Blast Furnace. (Quelques considérations au sujet des pousiéres de minerais entrainées per les gaz au guelard des Hauts fourneaux.) A. COUSIN. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June, 1930, pages 5–8.

Includes discussion. General comment on blast furnace design for work on ores that decrepitate. The dust ejected increases in parabolic relation to the velocity of the throat gases. A larger diameter and a different profile, for which reference should be made to the illustrations in the original article, are suggested to reduce gas velocity and separate the dust from the gases. HWG(31)

Lead Refining at the Bunker Hill Smelter of the Bunker Hill & Sullivan Mining & Concentrating Co. ALFRED F. BEASLEY. *Transactions American Institute Mining & Metallurgical Engineers*, 1930, pages 265–274

Includes discussion. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 51 (31)

Improvements in the Metallurgy of Quicksilver. L. H. DUSCHAK. *Transactions American Institute Mining & Metallurgical Engineers*, 1930, pages 283–298.

Includes discussion. See *Metals & Alloys*, Vol. 2, July 1931, page 139. (31)

Tin Industry of Yunnan, China. MARSHALL D. DRAPER. *Mining & Metallurgy*, Vol. 12, Apr. 1931, pages 178–186; May 1931, pages 242–247; *Mining Journal*, London, Vol. 173, May 23, 1931, page 415; May 30, 1931, pages 430–431; June 6, 1931, pages 452–453; June 13, 1931, page 472; June 20, 1931, pages 494–495; June 27, 1931, pages 509–510.

The occurrence of the ore, its mineralogy, concentration and smelting are described in detail. AHE(31)

Possibility of Improvement of the Blast Furnace. (Le possibilité de l'evolution du haut forneau.) V. DEFAYS. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th Session, Liege, June 1930, pages 49–54; *Chimie et Industrie*, Special Number, Mar. 1931, pages 504–510.

Speculations on possible improvements. HWG(31)

The Electric Blast Furnace Gas Purification Plant, System Lurgi, at the Lübeck Blast Furnace Plant. (Die elektrische Hochofengas-Reinigung, Bauart Lurgi, auf dem Hochofenwerk Lübeck.) J. DREHER. *Stahl und Eisen*, Vol. 51, May 7, 1931, pages 577–587.

Report No. 118 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. Construction, operation and practical results are considered. The purification plant is built for a capacity of 40,000 m.³/hr. and purifies the blast furnace gas in 2 steps. The dust is deposited partly in the pre-purifier and partly in the post-purifier which also acts as dryer. A gas cooler is installed between the 2 purifiers. This arrangement guarantees an economical purification and drying of the gas independent of the working of the blast furnace and its charge and also independent of the electrical, chemical and physical properties of the dust. The cost of this purification method is somewhat higher than that of other methods but is balanced by the better quality of the gas. In the discussion, the economics of the method were doubted by some speakers. GN(31)

The Dressing of the Copper Spar Products of the Mine Eisernhardter Tiefbau and the Additional Flotation. (Die Aufbereitung der Spatkupferprodukte der Grube Eisernhardter Tiefbau und ihre Ergängung durch die Flotation.) E. BIERBRAUER & H. GLEICHWURM. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 8, 1931, Report 178, pages 121–129; *Stahl und Eisen*, Vol. 51, July 16, 1931, page 917.

Since the previous dressing methods of the spathic ore mined by the above mentioned mine proved insufficient to fully separate its Cu content, a new additional flotation process was developed by this investigation. The ore contains Fe, 31.4%; Mn, 5.7%; Cu, 0.45%; residue, 18.7%. The new method which was developed gave excellent results. GN(31)

Mesothorium. G. MALCOLM DYSON. *Industrial Chemist*, Vol. 7, June 1931, pages 231–232.

Bibliography of 15 references given. There are 2 processes for the extraction of Th from the minerals which contain it, namely, the production of Th from "Th rich" minerals, in which the thorianite or similar mineral is powdered after hand sorting, heating to dryness with sulphuric acid, and the Th extracted with very dilute nitric acid; and the process for "Th poor" ores, which comprise the monazite sand series. A method for the latter is given in considerable detail. A brief discussion of the luminosity of mesothorium and the use of mesothorium in medicine is given. RAW(31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Application of Decorative Finishes to Crown Caps. F. J. GAVIN. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1057–1059.

Tin-plate and black-plate are the most widely used metals in this field; the metal generally is of the 65–107 lb. variety. The plate is cleaned and coated with a sanitary lacquer of gilsonite-China wood oil color varnish, which is baked in the automatic oven at 375–420° F. for 20–22 min. All outside coatings or lithographs must be water- and heat-resistant. Coatings for crown caps do not require a great degree of elasticity, so that the finish can be harder, thus increasing resistance to abrasion and pasteurization. MS(32)

Screw Cap Coatings. F. J. GAVIN. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 965–968.

Confined to caps for sealing foodstuffs and medicinals. Enamels used are usually combinations of TiO_2 or ZnO pigments ground in China wood or linseed oil containing resins. Lacquers consisting of gilsonite, resin, China wood oil mixtures are widely used. The sheet metal is thoroughly cleaned, and is then coated by means of a coating machine. For best results, thickness of individual films should not be more than 0.00035 in. Tests have shown that a finished coating 0.001 in. thick is 50 times more resistant to attack if this thickness is built up in 3 well baked coats of 0.00033 in. each than if applied in 1 coat. Enameling practice generally consists of applying 1 to 6 coats, depending upon severity of attack of material to be sealed. Baking temperatures for each coat vary from 150° F. for 1 hr. to 350-450° F. for 20–45 min. Baking is generally done in automatic ovens. The caps are then stamped and threaded from the coated sheets. The threading operation subjects the coating to severe stresses, thus often resulting in fracture and abrasion of the coating. This is true particularly of coatings on small diameter caps. Number of outside coats should be limited to as few as are necessary, as failures during threading are most often directly proportional to the number of outside coats. MS(32)

Economies in Lacquer Finishing. CARL E. BRETNEY. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 973–974.

Economies can be effected in the finishing of metal surfaces with lacquers through the use of colored lacquers which hide small defects in the metal surface, by using suitable drawing lubricant which is easily removed, and by the selection of suitable finishing equipment. MS(32)

Bituminous Pipe Coatings. RUSSELL R. BRANDT. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 799–801.

Natural asphalts, petroleum pitch, and coal-tar pitch are basic materials used in coatings for steel pipe to prevent corrosion. Coal tar primers are applied most satisfactorily by spraying. Bituminous coatings other than primer coats are usually applied by dipping into molten asphalt. Such coats are used to prevent soil corrosion. Pipe is also coated by wrapping with a felt cloth impregnated with bitumen. Asphalt emulsions are also finding application. MS(32)

Methods of Coating Steel Pipe to Prevent Corrosion. RUSSELL R. BRANDT. *Metal Cleaning & Finishing*, Vol. 2, Oct. 1930, pages 873–876.

Discusses commonly used methods of applying oil coatings to prevent corrosion. MS(32)

The Effect of Smelter Atmospheres on the Quality of Dry Process Enamels for Cast Iron. ANDREW I. ANDREWS & H. WILBUR ALEXANDER. *University of Illinois Bulletin* No. 227, May 19, 1931, 18 pages.

Except for the leadless Sn enamel, reducing atmospheres in the smelter were deleterious to all enamels tested. Metallic oxides are reduced, there is a loss of opacity and black spots appear on burning. Reducing atmospheres in the presence of high percentages of SO_2 were deleterious to all enamels tested. High lead enamels are least resistant. CHL(20)

PATENT DEPARTMENT

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United States Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Metallic bellows and method of producing the same. W. H. Buell, 1,825,652, 12/3/27.
Clay gun. W. Johnston, 1,825,734, 4/20/29.
Ore leaching process. G. Mott, 1,825,752, 3/2/27.
Method of plating metals. W. E. Watkins, 1,825,763, 4/9/29.
Reversing valve and equipment for combustion control. R. D. Nye, 1,825,815, 6/11/28.
Welding rod. W. F. Stoody, *et al.*, 1,825,829, 11/13/29.
Method of melting metals. L. R. Zifferer, *et al.*, 1,825,841, 4/17/30.
Method of making metal strips. W. C. Coryell, 1,825,854, 12/9/29.
Roasting apparatus. E. J. Fowler, *et al.*, 1,825,947, 5/16/28.
Process of treating ores. C. C. Haas, 1,825,949, 5/28/28.
Differential adjustment for rolls. J. Johnson, 1,825,957, 1/20/27.
Making metal articles. A. Kadow, 1,825,958, 1/10/27.
Process of and compound for hardening the surface of mild steels. H. J. Lorang, 1,826,008, 5/27/29.
Pipe flask. J. R. McWane, 1,826,083, 9/9/29.
Electroplating. L. R. Westbrook, 1,826,159, 7/11/27.
Process of treating metallurgical slimes. H. Lehrecke, 1,826,183, 6/18/30; Germany 6/28/29.
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Process of manufacturing gray pig iron. F. Greiner, 1,826,211, 5/14/28; Germany 5/27/27.
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Method of refining ferrochrome. K. M. Simpson, 1,826,261, 4/10/29.
Arc-welding. J. F. Lincoln, 1,826,355, 1/12/23; 1,827,245, 3/20/22.
Seamless tube mill. J. V. Mazurie, *et al.*, 1,826,360, 4/18/30.
Method of installing welded pipe systems and fittings therefor. J. L. Anderson, 1,826,377, 1/13/28.
Rolling mill repeater. A. C. Brauer, *et al.*, 1,826,451, 10/4/28.
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Composition of matter. (*W_3C-H.S. Steel.*) G. J. Comstock, *et al.*, 1,826,455, 4/9/28.
Metal aggregates. (*ZrO_2-Ni.*) G. J. Comstock, 1,826,456, 4/14/28.
Composition of matter. (*ZrO_2-H.S. Steel.*) G. J. Comstock, *et al.*, 1,826,457; Original 4/9/28; this 4/30/29.
Method and apparatus for treating drawn tubes. A. J. Johnson, 1,826,077, 7/29/29.
Process for dephosphorizing iron in the converter and means for carrying out said process. F. Bicheroux, 1,826,497, 4/4/29; Belgium 4/26/28.
Tungsten and method of manufacturing the same. W. B. Gero, *et al.*, 1,826,514, 11/26/26.
Treatment of metallic filaments. J. H. Ramage, 1,826,524, 11/10/27.
Guide for rolling mills. G. W. Sills, 1,826,531, 6/22/27.
Poppet valve and process of making same. R. Hervig, *et al.*, 1,826,542, 5/12/22.
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Blank and process for making valve tappets. R. Hervig, 1,826,544, 1/11/26.
Process of making composite valves. R. Jardine, 1,826,549, 7/9/24.
Extraction of tin from ores, alloys, scrap or the like. L. Lamy, *et al.*, 1,826,552, 1/24/30; France 6/22/29.
Process of metallurgical treatment. C. Thurneyssen, 1,826,583, 2/19/27; France 2/23/26.
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Apparatus for soldering. A. H. Adams, 1,826,710, 7/15/30.
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Electrolytic production of alkali and alkaline earth metals. J. J. Grebe, *et al.*, 1,826,773, 7/5/28.
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Apparatus for the manufacture of expanded steel load bearing members. H. M. Gersman, 1,827,314, 2/19/25.
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Skimmer. R. J. Anderson, 1,827,504, 8/15/30.
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Manufacture of railway and tramway rails. C. P. Sandberg, *et al.*, 1,827,616, 5/29/29; Great Britain 9/29/28.
Electric arc welding. C. L. Ipsen, 1,827,657, 8/2/26.
Process of treating ores of titanium containing chromium and recovering the sulphuric acid. N. Specht, 1,827,691, 4/6/29; Germany 4/14/28.
Torch. J. L. Anderson, 1,827,697, 10/5/29.
Mold lining. J. B. Grenagle, 1,827,742, 9/26/29.
Reduction of metallic compounds and production of arsenates. G. N. Kirsebom, 1,827,754, 7/18/28.
Treatment of cadmium-bearing material. G. N. Kirsebom, 1,827,755, 6/28/30.
Means for igniting ore. A. F. Beasley, 1,827,773, 10/21/29.
Ore sintering car. O. A. Oesterle, 1,827,799, 6/12/30.
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Process of making products with welded faces of stable surface alloy. P. A. E. Armstrong, 1,826,860, 1/16/24.
Proofing of metal against corrosion and particularly of iron and steel against rust. W. H. Cole, 1,826,866, 2/24/30; Great Britain 12/10/29.
Method of purifying ferrous metals. C. T. Hennig, 1,826,880, 8/22/28.
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Electric soldering iron. R. R. Hazlett, *et al.*, 1,826,933, 3/12/30.
Apparatus for normalizing steel sheets. F. W. Pitts, 1,827,038, 1/28/29.
Furnace. F. A. Fahrenwald, 1,827,079, 9/16/27.
Process for the treatment of aluminum. M. K. de Trairup, 1,827,142, 12/4/29; Great Britain 9/3/29.
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Tempering furnace. W. Grothe, 1,827,194, 8/27/28.
Method of protecting metal surfaces. S. R. Mason, 1,827,204, 10/18/27.
Method of welding. C. T. Siebs, 1,827,210, 12/4/28.
Treatment of iron and steel. C. M. Dennis, 1,827,223, 2/2/28.
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Apparatus for feeding electric furnace electrodes. J. G. Marshall, 1,827,852, 3/31/30.
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Torch. A. J. Fausek, *et al.*, 1,828,135, 6/5/29.
Ingot mold and method of making same. J. E. Perry, 1,828,200, 12/16/26.
Press for sheet metal. C. J. Rhodes, 1,828,201, 4/30/29; Great Britain 2/15/29.
Blende sintering process. L. Boscheron, 1,828,241, 2/21/30; Belgium 3/9/29.
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Electric induction furnace. E. F. Northrup, 1,828,291, 11/23/29.
Process for the manufacture of rails with hardened heads. H. Kurz, 1,828,325, 7/7/28; Germany 8/22/27.
Centrifugal casting method. W. H. Millspaugh, 1,828,335, 4/26/29.
Manufacture of iron carbonyl. M. Müller-Cunradi, 1,828,376, 8/10/25; Germany 8/11/24.
Rolling mill installation. M. A. McCreary, 1,828,426, 4/14/30.
Roller spun metal manufacture. W. R. Harrison, 1,828,464, 5/19/28.
Method and machine for forming sheets. E. B. Carns, 1,828,489, 4/22/29.
Casting. W. G. Goodwin, 1,828,495, 9/10/28.
Shaft for heat-treating furnaces. J. Sammon, 1,828,510, 12/17/27.
Soldering cup. R. L. Bruce, 1,828,520, 11/2/29.
Manipulator for ingots, blooms and the like. J. D. Pugh, 1,828,619, 9/16/26.
Method of improving metals, and products thereof. E. S. Fisher, 1,828,701, 6/25/24.
Rotary kiln. (*For treating ores.*) J. Andrews, 1,828,727, 5/24/28.
Method of making partially lined bearings. J. Brincil, 1,828,731, 1/21/29, original 3/26/28.
Desulphurizing nickel-containing matte. A. S. Shoffstall, *et al.*, 1,828,752, 5/3/28.
Process for the refining of chromium ores. P. Weise, *et al.*, 1,828,756, 3/30/28, Germany 4/16/27.
Process of glazing refractory articles. G. S. Diamond, 1,828,767, 10/3/28.
Metallurgical furnace. F. A. Fahrenwald, 1,828,836, 6/17/29.
Heat-treatment chamber. W. A. Morton, *et al.*, 1,828,904, 2/5/28.
Wire drawing capstan. W. E. Carroll, 1,828,922, 7/13/29.
Method of annealing fusion welds. S. W. Miller, 1,828,977, 10/5/28.
Mold for casting refractories. F. W. Schroeder, 1,829,114, 7/9/20.
Process for the coating of metals upon cement surfaces. S. Seailles, *et al.*, 1,829,116, 9/25/24; France 9/29/23.
Process for making steel insensible to the action of hot gases and vapors. B. Strauss, 1,829,118, 11/18/26; Germany 4/1/26.
Metallurgical process. L. A. Wilson, 1,829,124, 11/11/27.
Rolling mill. E. G. Budd, 1,829,126, 2/23/28.
Metallurgical apparatus. A. P. Roux, 1,829,158, 6/28/29.
Metal concrete for hearth plates and the like. H. H. Harris, 1,829,218, 5/9/28, original (abandoned) 7/9/24.
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Means for charging blast furnaces and the like. C. M. Rutter, 1,829,300, 10/2/29.
Crucible furnace lining. H. E. White, 1,829,320, 1/3/29.
Process of rolling metal. M. C. Corrigan, *et al.*, 1,829,339, 7/17/29.

Tuyère. G. H. Hughes, 1,829,356, 7/15/30.
Control of temperature in electric furnaces and the like. A. G. Lobley, 1,829,-416, 9/22/26; Great Britain 10/1/25.
Reduction of ores, oxides and the like. H. E. Coley, 1,829,438, 1/5/31.
Electric soldering means. W. Schmidt, 1,829,457, 5/27/29.
Ingot turning machine. F. L. Sabin, 1,829,573, 9/18/26.
Blowpipe apparatus. F. C. Hasse, 1,829,592, 6/1/29.
Method and apparatus for cleaning sheet metal. H. E. McCrery, 1,829,599, 12/15/27.
Process of treating metals. (*Corrosion prevention.*) J. G. E. Wright, 1,829,-623, 11/16/29.
Method of making alloys. W. P. Davey, 1,829,635, 5/28/29.
Electrically welded jarred steel. A. G. Egler, 1,829,638, 1/13/31.
Aluminum alloy. W. Morrill, 1,829,668, 2/4/31.
Furnace. (*Furnace closure.*) N. R. Stansel, 1,829,684, 8/21/29.
Caustic bath. (*For removing enamel.*) M. W. Ward, 1,829,693, 9/29/30.
Prevention of corrosion in oil wells. J. C. Walker, 1,829,705, 3/12/25.
Carburizing and annealing furnace. A. D. Dauch, *et al.*, 1,829,710, 12/11/28.

Austrian Patents

Subject of Invention, Patentee, Patent No. and Date of Beginning of Term of Patent.

Method of removing blast-furnace throat dust from gas mains. Vereinigte Stahlwerke Akt.-Ges., 124,701, 5/15/31.
Process for producing pure iron. H. J. Van Royen, 124,687, 5/15/31.
Means for producing pipeless ingots. E. Bornand, *et al.*, 124,702, 5/15/31.
Contact elements for leading current into wire, strip, etc., which is being annealed. F. Krupp Akt.-Ges., 124,713, 5/15/31.
Process for electrolytically reducing the oxide layer of metal oxide rectifiers. Siemens-Schuckertwerke Akt.-Ges., 124,635, 5/15/31.
Device for lifting and depositing molds, particularly for interchangeable molds on casting machines. Soc. An. des Hauts-Fourneaux et Fonderies de Pont-à-Mousson, 124,769, 5/15/31.
Process for making chromium-aluminum alloys, using chromium-rich pre-alloys of aluminum. H. T. Tillquist, 124,697, 5/15/31.
Process for producing metallic magnesium by reduction of magnesium compounds with carbon in the electric arc. Oesterreichische-Amerikanische Magnesit Akt.-Ges., 124,696, 5/15/31.
Continuous process for pickling and annealing sheets. Copperized Steel Ltd., 124,685, 5/15/31.
Process for joining metal parts by soldering or welding. N. V. Philips' Gloeilampenfabrieken, 124,707, 5/15/31.
Process for treating rolled material, particularly wire or rod, prior to drawing. R. W. Moll, *et al.*, 124,710, 5/15/31.
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Subject of invention, Patentee, Patent No. and Filing Date.

Note: When the date given differs from that at which the application was lodged at the British Patent Office, the former date is given, followed by *.

Extrusion apparatus. Western Electric Co., Ltd., 356,758, 6/11/30*.
Testing of electrical and/or magnetic characteristics of metal sheets. Ferranti, Ltd., *et al.*, 356,690, 3/4/30.
Handling of furnace residues. T. G. Coghlan, 356,733, 4/22/29*.
Extrusion presses for metal rods, tubes and the like. Scovill Mfg. Co., 356,779, 4/7/30.
Manufacture of bent pipes or tubes. Stewarts & Lloyds, Ltd., *et al.*, 356,781, 4/14/30.
Cast iron article and method of manufacturing same. Ford Motor Co., Ltd., 356,795, 6/21/29*.
Production of a material more particularly for building and street structural purposes. Aluminiumerz Bergbau und Industrie Akt.-Ges., 356,797, 6/10/29*.
Lead calcium alloys for sheathing cables. Standard Telephones & Cables, Ltd., 356,801, 10/30/29*.
Apparatus for straightening rolled metal plates. W. Sykes, 356,842, 6/23/30.
Presses for drawing sheet metal and the like. Marquette Tool & Mfg. Co., 356,858, 7/8/30; 357,328, 7/29/30.
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Method of rolling sections having transverse ribs. H. Seiferth, 356,968, 12/19/29*.
Manufacture of tubes. A. Vollmer, 357,005, 2/8/30*.
Apparatus for taking samples of metal ingots slabs, or the like. United States Metals Refining Co., 357,025, 12/18/29*.
Crucibles for electrolysis of fused electrolytes. Siemens & Halske Akt.-Ges., 357,032, 12/23/30.
Furnace electrodes. Vereinigte Aluminium-Werke Akt.-Ges., 357,047, 1/23/30*.
Electric arc-welding. International General Electric Co., Inc., 357,062, 2/18/30*.
Cushioning device for sheet-metal drawing-presses. Marquette Tool & Mfg. Co., 357,182, 6/18/30.
Treatment of chromium-nickel-iron-carbon alloys. F. Krupp Akt.-Ges., 357,254, 6/24/29*.
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Pickling of metals and the like processes. Imperial Chemical Industries, Ltd., 357,387, 10/9/29*.
Brass-melting apparatus. A. W. Machlet, 357,410, 11/10/30.
Process for protecting magnesium and magnesium alloys from attack by hot baths of saline melts. I. G. Farbenindustrie Akt.-Ges., 357,428, 12/11/29*.
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Ingo strippers. E. J. George, *et al.*, 357,529, 4/23/30.
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Method of treating cadmium-plated goods. C. T. Neal, 357,887, 12/23/30.
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Electrical heating elements. G. Bray & Co., Ltd., *et al.*, 357,969 (Addition to 221,180), 4/30/30.
Process and apparatus for purifying zinc ore. O. Gerlach, 358,039, 5/27/30.
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Apparatus for casting and trimming curved stereotype printing plates. H. Brown, 357,981, 6/30/30.
Valves for regenerative furnaces, heating apparatus and the like. S. Wohlfahrt, 358,257, 9/23/30.
Cupola furnaces. W. G. Gass, 358,267, 9/30/30.
Rolling mills for rolling metals. Emery Bros., Ltd., *et al.*, 358,291, 10/15/30.
Rotary drum furnaces. Firma: J. D. Brackelsberg, 358,352, 11/29/30.
Methods and devices for forming grids for accumulator plates by casting. Etablissements G. Briere, 358,357, 12/2/29*.
Method of and apparatus for casting metals and ceramic masses and other suitable materials by the centrifugal process. P. C. Fritzsche, 358,363, 12/9/30.
Casting molds for use in the manufacture of cast-iron socket pipes by centrifugal casting. F. Krupp Akt.-Ges., 358,365, 12/13/29*.
Manufacture of piping by extrusion. C. O. Evans, 358,379, 3/5/30*.

Canadian Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Furnace linings. (*Particles of silica in copper oxides.*) The American Smelting & Refining Co., 315,629, 5/28/30.
Furnace for roasting sulphide ore. The Complex Ores Recoveries Co., 315,661, 6/4/29.
Method of drawing hollow articles from sheets of magnesium and alloys. I. G. Farbenindustrie Akt.-Ges., 315,672, 9/27/29.
High grade magnesium alloy. Same patentee, 315,675 & 315,676, 11/11/30.
Process of forming iron alloy articles. The General Reduction Co., 315,700, 6/26/30.
Ore slag processing. La Soc. An. pour le Traitement des Minerais Alumino-Potassiques, 315,748, 1/13/31.
Process and apparatus for electrically forging iron and steel bars. La Soc. Holding de Brevets et Procèdès Giacchino pour l'Ebauchage Electrique S. A., 315,750, 8/18/28.
Magnetic structure. The Western Electric Co., 315,757, 4/22/29.
Alloy. (*Silver nodule material from electrolytic copper refining.*) H. M. Frederikssen, 315,801, 9/8/30.
Molding machine. E. Leyóndre, 315,810, 8/26/29.
Process of treating metallic oxides by hydrocarbons. A. Moreschi, 315,812, 5/3/28.
Die casting machine. The A. C. Spark Plug Co., 315,844, 3/14/29.
Process of making self-baking electrodes. Det Norske A/S for elektrokemisk Industri of Norway, 315,898, 12/6/28.
Stain resisting wrought article. (*Fe-Cr-Mn-C.*) The Electro Metallurgical Co. of Canada, Ltd., 315,911, 9/26/30.
Stain resisting wrought article. (*Fe-Cr-Mn-Cu-C.*) Same patentee, 315,912, 9/26/30.
Stain resisting cobalt alloy. (*Fe-Cr-Mn-Co-C.*) Same patentee, 315,913, 9/26/30.
Corrosion resistant article. (*Resistant to hot sulphurous gases.*) Same patentee, 315,914, 9/26/30.
Alloy. (*Fe-Cr-Mn-Mo.*) Same patentee, 315,915, 9/26/30.
Method of shaping metallic bodies. The Firth-Sterling Steel Co , 315,923, 5/16/30.
Carbon-free metal. (*Castings containing nickel.*) The International Nickel Co., Inc., 315,941, 11/10/27.
Zinciferrous material reduction. The New Jersey Zinc Co., 315,951, 12/15/30.
Electric resistance (Zr base). The Radio Corp. of America, 315,963, 12/9/29.
Light metal alloy. (*Al-Mg-Mn.*) P. Pritchard, *et al.*, 315,992, 1/24/31.
Annealing furnace. J. R. Garner, *et al.*, 316,010, 10/31/30.
Process of treating ores. E. J. Kohlmeyer, *et al.*, 316,014, 12/11/30.
Process of tempering metals. S. Marciniak, 316,062, 10/8/30.
Machine for pressing nuts from balls. W. Nussbaum, 316,068, 2/11/30.
Alloys for the manufacture of edge tools. (*Fe-Cr-Mn-C.*) A. E. G. T. von Vegesack, 316,081, 6/5/30.
Alloy. (*Cr group metals, nitrides thereof & lower melting metal.*) R. R. Walter, 316,084, 5/12/28.
Metal composition. (*Tungsten nitride, Co and Cr-group metal.*) R. R. Walter, 316,085, 8/25/28.
Tin recovery from scrap tinned metal. The African Tin Recovery Co., Ltd., 316,087, 12/26/30.
Copper melting furnace. The American Metal Co., Ltd., 316,088, 7/9/30.
Chain casting and repairing apparatus. The Moline Malleable Iron Co., 316,134, 11/28/30.

Danish Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Process and machine for casting molten metal under pressure. R. H. V. Christensen, *et al.*, 44,494, 1/7/30.
Metallic mold for die- or pressure-casting. Same patentees, 44,494, 4/7/30.
Refining cupola. P. Marx, 44,498 (2nd addition to 42,576), 12/22/30.
Metal tubing and other objects for high-temperature service. H. G. A. von Kantzow, 44,525, 9/16/30.

French Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Electric salt bath furnace. A. G. E. Hultgren, 712,063, 2/25/31.
Nickel alloy. Siemens & Halske Akt.-Ges., 712,076, 2/25/31.
Process for making iron and steel. Hirsch, Kupfer und Messingwerke Akt.-Ges., 712,194, 2/26/31.
Apparatus and processes for annealing metals without oxidation. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 712,236, 2/27/31.
Process for welding aluminum. M. Navarro, 712,030, 2/24/31.
New welding process. R. Sarazin, 712,152, 12/19/30.
Improvements to electric resistance furnaces. W. S. Smith, *et al.*, 712,082, 2/25/31.
Process for making steel ingots which are free from defects, and means for working this process. J. K. Hruska, 713,042, 3/11/31.
Process for making alloys, and tools made of these alloys. Fansteel Products Co., Inc., 713,086, 3/11/31.
Alloys of refractory metals, and tools made of these alloys. Same patentee, 713,087, 3/11/31.
Alloys of cobalt and molybdenum. Vereinigte Stahlwerke Akt.-Ges., 713,130, 3/12/31.
Improvements to machines for plugging tap holes. Mécanique Moderne & Anker Réunis, 713,156, 3/13/31.
Alloys of nickel and tin. Vereinigte Stahlwerke Akt.-Ges., 713,193, 3/13/31.
Process for making acid-resistant iron. Bamag-Meguin Akt.-Ges., 713,198, 3/13/31.
Process for improving inoxidizable steels. Soc. An. des Aciéries & Forges de Firminy, 713,221, 3/14/31.
Process for making alloys. Same patentee, 713,225, 3/14/31.
Alloys of nickel and molybdenum. Vereinigte Stahlwerke Akt.-Ges., 713,233, 3/14/31.
Process for producing iron having a high silicon content. Bamag-Meguin Akt.-Ges., 713,240, 3/14/31.
Alloys for making high-strength brasses. A. E. Le Thomas, 713,253, 3/16/31.
Production of very hard alloys. Vereinigte Stalhwerke Akt.-Ges., 713,358, 3/16/31.
Steel or cast iron having only slight tendency to rust. Vereinigte Stahlwerke Akt.-Ges., Addition 39,431 (1st addition to 695,398, 5/10/30), 11/28/30.
Cupola. P. Marx, Addition 39,485 (2nd addition to 663,942, 11/14/28), 12/26/30.
Process and apparatus for producing thin metal films. Electrical Research Products, Inc., 713,027, 3/11/31.
Process and machine for making tubes. L. Hinkel, *et al.*, 713,041, 3/11/31.
Process for cleaning metal surfaces. J. H. Gravell, 713,060, 3/11/31.
Process for making objects of thin metal, and objects made by this process. Driver Harris, 713,167, 3/13/31.
Process for rolling sheet zinc. F. Jordan, 713,181, 3/13/31.
Process for pickling inoxidizable steels. Soc. An. des Aciéries & Forges de Firminy, 713,219, & 713,220, 3/14/31.
Equipment for welding thin sheets. Fried. Krupp Akt.-Ges., 713,223, 3/14/31.
Improvements to extrusion presses. Imperial Chemical Industries, Ltd., 713,344, 3/16/31.
Process for making autogenously welded chains. Krafft & Schull, 713,371, 3/16/31.
Transformer coil coupling for welding machines. C. E. J. Brandt, 713,392, 3/17/31.
Automatic contact breaker for welding machines. C. E. J. Brandt, 713,393, 3/17/31.
Process and apparatus for casting metals and ceramic masses by centrifugal force. C. Fritzsche. Addition 39,477 (1st addition to 687,459, 12/-31/29), 12/19/30.
Improvements to polyphase induction furnaces. Soc. Générale d'Applications Electro-Thermiques, 713,294, 6/24/30.
Process for attaching a tool element or tip of refractory metal to a part or holder of ordinary metal. Fansteel Products Co., Inc., 713,474, 3/18/31.
Metal-working tool and process for making it. Same patentee, 713,475, 3/18/31.
Alloys of cobalt and tungsten. Vereinigte Stahlwerke Akt.-Ges., 713,428, 3/17/31.
Non-magnetic steel. Fried. Krupp Akt.-Ges., 713,445, 3/18/31.
Process for decomposing minerals containing lithium. Metallges. Akt.-Ges., 713,446, 3/18/31.
Process for preparing alloys. American Smelting & Refining Co., 713,550, 3/19/31.
Antifriction metal compositions. S. & T. Metal Co., 713,603, 3/20/31.
Improved aluminum alloys. Rolls-Royce, Ltd., 713,604, 3/20/31.
Cooling means for dissipating the heat produced during brazing or welding objects, particularly conductor cables. Allgemeine Elektricitäts Gesellschaft, 713,473, 3/18/31.
Improvements in the manufacture of tubes, particularly those for the transmission of heat. W. J. Still, 713,477, 3/18/31.
Rolling process. H. Seiferth, 713,597, 3/20/31.
Machine for drawing tubing. Demag Akt.-Ges., 713,680, 3/23/31.
Rolling mill roll and process for making the same. L. Quincy, 713,706, 3/23/31.
Improvements to electric induction furnaces. E. F. Northrup, 713,498, 3/18/31.
Machine for lining with antifriction metal. Bohn Aluminum & Brass Corp., 714,060, 3/30/31.
Process for welding scrap iron together, avoiding burning. Th. Goldschmidt Akt.-Ges., 713,799, 3/24/31.

Process for making chrome-nickel alloys. The General Electric Co., Ltd., 713,807, 3/24/31.

Production of chromium and its alloys with other metals, particularly nickel and similar metals. Same patentee, 713,808, 3/24/31.

Method and means for cooling materials annealed in pots. Felten & Guilleaume Carlswerk Akt.-Ges., 713,837, 3/25/31.

Process for refining metals. American Smelting & Refining Co., 713,916, 3/26/31.

Improvements to processes for brazing. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 713,751, 3/20/31.

Process for welding with the aid of chemically and electrically produced heat and welding rod for working this process. Soc. An. de Ateliers de Secheron, 713,860, 3/25/31.

Improvements to lead presses. Electric Hose & Rubber Co., 713,935, 3/27/31.

Tilter for rolling mills. Fried. Krupp Grusonwerk Akt.-Ges., 714,030, 3/30/31.

Process and apparatus for examining materials with X-rays. N. V. Philips' Gloeilampenfabrieken, 713,854, 3/25/31.

Electric resistance furnace. E. F. Russ, 713,789, 3/24/31.

Process for treating ores and other materials in the electric furnace. A. H. C. Deacon, 714,328, 7/12/30.

Copper ingots for rolling and process for producing the same. Anaconda Copper Mining Co. Addition 39,551 (1st addition to 635,865, 6/11/27), 12/15/30.

Process for treating iron baths in steel furnaces. Fried. Krupp Akt.-Ges., Friedrich Alfred Hütte. Addition 39,552 (1st addition to 80,154, 8/10/29), 12/16/30.

Process for making objects of phosphorous steel and objects made by this process. Vereinigte Stahlwerke Akt.-Ges., 714,068, 3/30/31.

Improvements to atomic-gas blowpipes. Cie. Française pour l'Exploitation des Procédés Thomson-Houston, 714,147, 4/1/31.

Method of assuring the tightness of joints made by welding metal sheets together. Soc. Nouvelle de Métallisation, 714,258, 7/3/30.

Process and machine for making hollow bodies, particularly tubing, by drawing around a mandrel. Metallges. Akt.-Ges., 714,271, 7/7/30.

Improved device for the automatic doubling of ovals in rolling mills. Soc. des Forges de Chatillon, Commentry & Neuves-Maisons, 714,290, 7/9/30.

Process for protecting articles of magnesium and its alloys. Soc. Continentale Parker, 714,321, 7/12/30.

Process for making metal sections. H. Seiferth. Addition 39,540 (1st addition to 689,116, 1/30/30), 12/10/30.

Process for heating by induction and furnaces using this process. Ugine-Infra, 714,246, 7/1/30.

Process for preventing contamination of the atmosphere of rooms containing electrolytic cells, and materials used for this purpose. Anaconda Copper Mining Co. Addition 39,569 (1st addition to 690,437, 2/22/30), 1/5/31.

Process for preparing a metal in very finely divided form and product made therewith. Soc. l'Auxiliaire des Chemins de Fer & de l'Industrie, 714,264, 7/4/30.

Process for reducing tin, particularly from material containing or not containing zinc or other metals. Berzelius Metallhütten G. m. b. H., 714,588, 3/31/31.

Three-high rolling mill. Fried. Krupp Grusonwerk Akt.-Ges., 714,609, 4/2/31.

Process for purifying the molten fluxes used in the production of light metals. Soc. d'Electrochimie d'Electrométallurgie et des Aciéries Electriques d'Ugine, 714,702, 8/5/30.

Process for making sponge metal. E. G. T. Gustafsson, 714,459, 3/5/31.

Improvements to machines for making elements or lattices of expanded metal. Kalman Steel Co., 714,467, 3/7/31.

Process for making blow-hole-free metal castings, especially of magnesium alloys, by introducing hydrogen into the molten metal. P. D. Brenna, 714,473, 3/10/31.

Process for making foundry cores. Imperial Chemical Industries, Ltd., 714,575, 3/28/31.

Process for welding tubing. H. Trunkwalter, 714,613, 4/2/31.

Aluminum conduit. A. C. Becker, 714,623, 4/2/31.

Method and means for stamping forgings by rolling. Soc. des Forges et Aciéries de Commercy, 714,651, 7/29/30.

Device for facilitating placing the blank and for increasing the useful work and rapidity of the operations in heavy-duty draw-presses. Schneider & Co., 714,703, 8/5/30.

Improvements to tunnel furnaces. Woodall-Duckham (1920), Ltd., *et al.*, 714,439, 2/26/31.

Alloys capable of being forged and hardened. Vereinigte Stahlwerke Akt.-Ges., 714,829, 4/4/31.

Electric furnace for annealing metal strip, wire, sheet or small objects. Otto Junker G. m. b. H., 714,865, 1/13/31.

Automatic arc welding machine. R. Sarazin, 714,709, 4/2/31.

Die holder for presses for sheathing submarine cables. Fried. Krupp Grusonwerk Akt.-Ges., 714,733, 4/3/31.

Improvements to machines for straightening rods and tubing. T. W. Hartley, 714,818, 4/4/31.

Apparatus for bending tubing and the like. G. L. P. Oger, 714,896, 4/7/31.

Articles which are resistant to the action of molten metals. Fried. Krupp Akt.-Ges., 714,938, 4/8/31.

Improvements to copper cooling valves made by forcing a blank through a die. Thompson Products, Inc., 714,939, 4/8/31.

Radiologic installation, particularly for examining materials. N. V. Philips' Gloeilampenfabrieken, 714,828, 4/4/31.

Improvements to anodes and to processes for making them. The International Nickel Co., Inc., 714,869, 3/11/31.

Refractory lining for rotary furnaces. H. von Ferber, 714,982, 4/9/31.

Hard alloy for tools and instruments. Fried. Krupp Akt.-Ges., 715,148, 4/13/31.

Process for making metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 715,206, 4/14/31.

Driving spindle for rolling mills. Schloemann Akt.-Ges., 715,207, 4/14/31.

Improvements to hard-metal compositions and to processes for making them. Cie. Française pour l'Exploitation des Procédés Thomson-Houston. Addition 39,595 (10th addition to 654,210, 4/4/28), 11/21/30.

Improvements to processes and apparatus for welding, and to the welded products. The Youngstown Sheet & Tube Co., 715,039, 4/9/31.

Improvements to welding apparatus. Same patentee, 715,078, 4/10/31.

Process for electroplating metals with alloys of copper and zinc. Firma Hille & Muller, 715,082, 4/10/31.

Process and mold for making ingots of finely granular structure and without pipes or blowholes. Vereinigte Aluminiumwerke Akt.-Ges., 715,226, 4/14/31.

Process for welding with a continuous-current arc derived from an alternating polyphase system. Firme Jean Nassheuer, 715,311, 4/15/31.

Soldering iron and a device for feeding the solder. F. Dupau, 715,321, 4/-15/31.

German Patents

Subject of Invention, Patentee, Patent No. and Filing Date.

Emergency switch for wire-drawing machines. R. Breitenbach, 534,718, 4/24/30.

Means for automatically stopping the blocks of wire-drawing machines. C. Rasch, 534,901, 9/13/29.

Press for making seamless lead pipe bends and the like. P. J. Wilbertz, 534,719, 8/30/27.

Rolling mill for the continuous production of transverse projections on metal rods and the like. H. Seiferth, 534,804, 6/28/29.

Rotary muffle furnace. Sachtleben Akt.-Ges., für Bergbau und chemische Industrie, 535,063 (Addition to 506,145), 10/24/26.

Process and means for melting masses of dust, particularly blast-furnace throat dust. A. Dawans, 534,727 (Addition to 506,350), 10/14/27.

Method of protecting metallurgical furnace walls containing magnesium orthosilicate. Metallges. Akt.-Ges., 534,820, 12/16/28.

Rotary drum for mixing molten metals and their alloys. Meier & Weichelt, 534,915, 12/14/28.

Process for making chromium steels. E. Herget, 534,989, 2/22/27.

Apparatus for heat treating objects made of steel and the like. C. W. St. J. Rowlandson, *et al.*, 534,821, 4/4/28.

Electrically operated discharge device for an electrical heating chamber for the local annealing of objects. Standard Elektrizitäts Ges., 534,822, 3/-13/27, U. S. 3/12/26.

Process for making hot cathodes, in which barium is deposited directly on the core wire by distillation. Siemens & Halske Akt.-Ges., 535,091, 5/26/28.

Induction melting furnace. E. Vits, 535,180, 12/4/30.

Warming device for molten-metal containers. Vereinigte Stahlwerke Akt.-Ges., 535,181, 12/4/29.

Apparatus for preparing molding sand. A. Lentz, 534,840, 12/20/27.

Mixing machine having a rotary stirring device, particularly for molding sand. A. B. Smith, *et al.*, 534,841, 3/11/30, Great Britain 3/22/29.

Nozzle brick. T. Brinkmann, 534,939 (Addition to 525,435), 11/15/29.

Process and apparatus for melting and casting under pressure. W. A. Loth, 535,182, 6/23/28; France 7/21/27.

Process and machine for making centrifugal castings composed of one or more layers. W. Raym, 534,842, 11/20/28.

Process and machine for making hollow centrifugal castings. Soc. An. des Hauts Fourneaux & Fonderies de Pont-à-Mousson, 534,843, 8/14/28.

Installation for make cores for pipes. R. Ardelt, 534,844, 2/27/29.

Foundry installation having two superposed conveyor belts. The Osborn Mfg. Co., 534,845, 1/14/30.

Self-gripping holder for specimens being tested for strength. Firma L. Schopper, 534,747, 11/26/29.

Process for making protective and resistant coatings. Siemens & Halske Akt.-Ges., 534,794, 12/10/26, U. S. 12/18/25.

Process for making highly refractory chromitic objects. A. Sprenger, 535,223, 10/11/27.

Shaft furnace for sintering, roasting and burning. Vereinigte Stahlwerke Akt.-Ges., 534,963, 11/7/29.

Cooling bed having a plurality of runways. Demag Akt.-Ges., 535,453, 9/27/30.

Press for extruding metals. E. Röber, 535,334, 12/2/28.

Process for extruding a non-cylindrical lead sheath around cables or for extruding non-cylindrical pipes of lead and the like. Socaso Akt.-Ges., 535,454, 3/27/30.

Device for making balls out of hot pieces of rod. R. Bigge, 535,739, 11/8/29.

Roll for making sections having local depressions, elevations and the like. Vereinigte Stahlwerke Akt.-Ges., 535,740, 7/19/29.

Process for making metallic carbonyls. I. G. Farbenindustrie Akt.-Ges., 535,437, 9/18/28.

Device for removing and carrying off blast-furnace throat dust. Vereinigte Stahlwerke Akt.-Ges., 535,748 (Addition to 534,313), 12/12/29.

Process for making pure steel. H. Van Royen, 535,527, 12/16/26.

Method of working the Thomas (converter) process. W. Mathesius, 535,749, 9/27/28.

Process for making homogeneous titanium steel. W. Mathesius, *et al.*, 535,750, 3/17/29.

Method and means for cooling annealed material which is to be kept bright. H. Prüfert, 535,340, 3/23/28.

Heating and annealing furnace for sheets and plates. H. Bangert, 535,751, 7/15/30.

Electric arc-welding process. Kjellberg Elektroden & Maschinen G. m. b. H., 535,631, 11/8/28.

Molding machine having an endless conveyor belt for the flasks. J. H. Küster, 535,778, 6/6/29.

Electromagnetic holding device for patterns and flasks. G. Franksen, 535,286, 4/8/30.

Process for making foundry core binders. O. L. Beer, 535,561, 4/9/30.

Core for casting hollow rolls, made of annular pieces of refractory material. W. Studte, 535,779, 7/12/28.

Device for centering and securing the chaplets, in the molding of hollow castings. Buderus'sche Eisenwerke, 535,780, 8/17/29.

Machine for making thin-walled centrifugal-cast pipe. W. Bremicker, 535,562, 2/20/30.

Process and machine for making hollow centrifugal castings. Vereinigte Stahlwerke Akt.-Ges., 535,563, 11/4/27.

Pressure tank for devices for cleaning castings with a mixture of water and sand. Badische Maschinenfabrik & Eisengiesserei, 535,287, 10/24/30.

Process for working up ores and other metallic compounds by roasting, making use of fused salt. Gewerkschaft Gevenich, 535,394, 11/20/26.

Production of solutions containing gold and silver by dissolving these metals in solvents containing iodine. Chilesalpeter G. m. b. H., 535,294, 1/8/29.

Fine-grained eutectic aluminum casting alloy. Th. Goldschmidt Akt.-Ges., 535,345, 12/10/22.

Platinum alloy and process for improving the same. W. C. Heraeus G. m. b. H., 535,688, 2/18/28.

Process for the electrolytic production of magnesium. A. C. Jessup, 535,346, 7/16/26; France 7/29/25.

Machine for cleaning tin plate. J. H. Cole, 535,699, 2/13/30; Great Britain, 2/15/29.

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

1201 **Industrial Furnaces.**—The November issue of the "Stewart Melting Pot," sent out by the Chicago Flexible Shaft Company, contains a number of short articles on the heat treatment of steel, interspersed with pictures and descriptions of their forges, pots and furnaces.

1202 **Cleaning Castings.**—A folder describing their automatic return tumbling barrel has been sent out recently by N. Ransohoff, Inc., West 71st St., Cincinnati, Ohio. The equipment is illustrated.

1203 **Metal Lacquer.**—An attractive booklet prepared by E. I. DuPont de Nemours & Co. Inc., Wilmington, Del., is devoted to their clear lacquers for metal protection. It describes the tests to which these lacquers were subjected and the results which were obtained.

1204 **Roller Hearth Furnaces.**—Bulletin No. 318 of the W. S. Rockwell Co., 50 Church St., New York, gives technical information on physical factors affecting production of uniformly heat-treated products. The principles outlined are applicable to all products subject to heat-treatment in the metallurgical, ceramic and chemical industries.

1205 **Electrical Conductors.**—A new booklet sent out by the Aluminum Company of America, Pittsburgh, Pa., describes their "Channeluminum" electrical conductors. These conductors are formed of two structural channels placed to form a hollow square. Suggestions for the installation of the channels are given, together with diagrams and charts.

1206 **Flotation Reagents.**—A new booklet issued by the Hercules Powder Co., Wilmington, Del., describes the action of the various pine oils and terpene reagents in the flotation treatment of ores. Specifications of the various Hercules products used in flotation are listed.

1207 **Gears Made of Armor Plate.**—This 8-page booklet prepared by the International Nickel Co., New York, deals with the use of 5% nickel and "Krupp analysis" (nickelchrome) carburizing steels for motor truck gears and pinions, with special emphasis on methods of heat treatment and fabrication.

1208 **Electric Furnaces.**—The Process Engineering & Equipment Corp., 5 Falmouth St., Attleboro, Mass., has sent out a leaflet illustrating several special installations of their bright annealing furnaces. Another of their leaflets is devoted to bright silver soldering.

1209 **Polishing Machines.**—Catalog No. 1196 sent out by E. Leitz, Inc., New York, announces their one-spindle and two-spindle automatic metallographic polishing machines. Their new specimen holder is also described.

1210 **Pattern Aluminum.**—A folder prepared by the Niagara Falls Smelting & Refining Corp., Buffalo, N. Y., gives the composition of their various aluminum casting alloys, stressing their pattern aluminum. The Falls aluminum and alloy aluminum are available in ingots and shots as illustrated in the folder.

1211 **Conveying Equipment.**—In the new Wright No. 15 Condensed Catalog, each type of Wright hoisting and conveying equipment is briefly described. Among the types of equipment included in the catalog are: Hand Operated Chain Hoists, Trolleys, Trolley Hoists, Traveling Cranes, Jib Cranes and Electric Hoists. Copies may be obtained from the Wright Manufacturing Co., Bridgeport, Conn.

1212 **Valves.**—Stainless Steel valves manufactured by the Alloy Steel Products Co., 103 Clayton St., Boston, Mass., are built to withstand severe operating conditions of corrosion, oxidation, contamination and pressure. A leaflet describing them and giving the dimensions of the valves is available.

1213 **Copper.**—The October 1st issue of the Copper & Brass Research Association Bulletin, 25 Broadway, New York, features unusual applications of copper and its alloys. The bulletin is fully illustrated.

1214 **Galvanizing Equipment.**—A 39-page booklet compiled by the United Engineering & Foundry Co., Pittsburgh, Pa., covers the cardinal principles of sheet galvanizing and the necessary equipment for doing the work. The information is given in non-technical language.

1215 **Gas Furnaces.**—Several models of the Juthe gas furnaces are illustrated in a folder issued by the American Electric Furnace Co., Boston, Mass. A section plan of one of the furnaces is shown, its construction described and special features outlined.

1216 **Automatic Reversal of Open-Hearth Furnaces.**—Bulletin No. 841-Z of the Leeds & Northrup Co., Philadelphia, Pa., contains valuable information for those interested in the performance of their furnaces. Copies are available from the company.

1217 **Carborundum.**—An attractive little booklet, "The Romance of Carborundum," gives the story of the development of this manufactured abrasive. It is prepared by the Carborundum Co., Niagara Falls, N. Y. Another booklet by the same company is "Abrasives in the Service of Industry."

1218 **Refractory Cements.**—Performance Report RE-3, No. 40, of the Johns-Manville Corp., 292 Madison Ave., New York, covers the application and results obtained through the use of Super-Refractory Cement in Detroit electric furnaces at the McGill Metal Company's plant, Valparaiso, Ind. Every effort has been made to have this report correct in every detail.

1219 **Measuring Machines.**—The Zeiss Measuring Machines are sold in this country by George Scherr Co. Inc., 142 Liberty St., New York, and this company has sent out a booklet describing these machines and giving instructions for their use. It contains numerous illustrations and diagrams.

1220 **Fluxes.**—Krembs & Company, 669 W. Ohio St., Chicago, manufacture special fluxes for every metal that can be soft soldered, silver soldered, brazed, welded or spot welded, and have issued a leaflet listing and describing them.

1221 **Cadalyte.**—An attractive folder, "The Key to Lowest Possible Plating Costs," may be obtained from the Grasselli Chemical Co., 629 Euclid Ave., Cleveland, Ohio. It outlines the advantages of this process to the plater.

1222 **Pyrometers.**—Catalog No. 86 of the Leeds & Northrup Co., Philadelphia, describes the optical pyrometer method and illustrates various types of their optical pyrometers. One section of the catalog is devoted to the applications of these instruments. Catalog 87 of the same company is entitled "Potentiometer Pyrometers" and describes not only the instruments themselves but also accessories for them. Prices are given.

1223 **Eraydo Alloy.**—This new alloy of silver, copper and zinc is the invention of the employees of the Illinois Zinc Co., 332 S. Michigan Ave., Chicago, Ill. A booklet telling about it is available and the company will also furnish a sample of the alloy itself. It is particularly applicable to radios, being non-magnetic and non-corrosive.

1224 **Heat Treatment of Steels with Cyanides and Salts.**—An 80-page book published by the Roessler & Hasslacher Chemical Co., Niagara Falls, New York, gives information on the application and operation of cyanide baths for the low temperature nitriding of special alloy steels. An interesting booklet by the same company is "Trichlorethylene, Its Properties and Uses."

1225 **Rustless Iron.**—The Superior Steel Corporation, Pittsburgh, Pa., has prepared an attractive pamphlet on their chrome and nickel chrome iron alloys. Analyses and physical properties of these alloys are given, and illustrations of some uses to which they can be put are shown.

1226 **Galvanized Sheets.**—The American Zinc Institute, New York, has sent out a pamphlet which gives a brief outline of facts ascertained in their tests on various galvanized sheets and gives recommendations for obtaining galvanized roofing and siding sheets which will give superior service. Names of manufacturers licensed to produce "Zinc Institute Seal of Quality" sheets will be furnished on request.

1227 **Fahralloy.**—The story of Fahralloy and its many heat and corrosion resistant applications are given in a leaflet issued by the American Manganese Steel Co., Chicago Heights, Ill. The ten different grades of Fahralloy are described.

1228 **Heat Treating Furnaces.**—The new Ryan-Scully bulletin No. 15D describes and illustrates R-S standard electric rivet and small parts heating furnaces, type C for small parts heat treating, rivet and forge stock heating.

1229 **Sheet Rolling.**—The Wean Engineering Co. Inc., Warren, Ohio, has sent out reprints of an article, "Combination System for Sheet Rolling," which appeared in a recent issue of "Steel."

1230 **Silver Solder.**—Bulletin No. 3 of the Handy & Harman Co., 57 William St., New York, is devoted to the characteristics and uses of their silver solder. The same company has distributed copies of a reprint of an article on "Silver Solders," given by R. H. Leach before the American Society for Testing Materials.

1231 **Su Veneer.**—The Superior Steel Corp., Pittsburgh, Pa., has sent out a folder containing a sample of their Su Veneer, for use where solid rust resisting materials are not required. This Superior metal is said to be resistant to denting, scratching and corrosion and to be as strong and tough as steel.

1232 **Nickel Cast Iron News.**—The October issue of this publication of the International Nickel Co., 67 Wall St., New York, features an article on Walworth chrome nickel iron pipe. It also contains number 9 of their "Intimate Chats on Metallography."

1233 **Haynes Stellite.**—The first of a series of booklets embracing Haynes Stellite products, their uses and methods of application is entitled "Properties of Haynes Stellite." It is a 30-page loose-leaf pamphlet and is a very thorough discussion of this product.

1234 **Gas-Fired Carburizing Furnaces.**—A leaflet sent out recently by the Surface Combustion Co., Toledo, Ohio, discusses their counterflow carburizing furnaces from the standpoint of economy and efficiency. Performance data are given.

1235 **Tube-Turns.**—Data on the new series 1R fittings of the Tube-Turn line are given in a bulletin sent out by Tube-Turns, Inc., 1303 S. Shelby St., Louisville, Ky. The addition of this new series rounds out the line affording 45″ and 90″ elbows and 180″ return-type fittings for welding in sizes 3/4″ through 20″ and in virtually all the weights required by modern piping.

1236 **Carburizing.**—The Carbonal process for carburizing steels in the electric vertical carburizer is described in Bulletin 931 of the Hevi Duty Electric Co., Milwaukee, Wis. Cost data are given and the bulletin is profusely illustrated.

1237 **Arc Welding.**—Data Bulletin No. 15 of the Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., gives methods of inspecting and testing welds.

1238 **Blowoff Equipment.**—The Permutit Co., 440 Fourth Ave., New York, has issued a pamphlet telling how to save fuel and improve steam quality with their blowoff equipment. Illustrations and diagrams are given. The same company has also prepared a number of leaflets on their electrochemical feed.

1239 **Cemented Tungsten Carbide.**—A 31-page booklet compiled by the Carborundum Co., Niagara Falls, N. Y., gives some information on grinding cemented tungsten carbide. A large part of the booklet is devoted to a description of the process. Another bulletin by this company is entitled "Carborundum and Aloxite Brand Wheels and Mounted Points for Portable Grinders."

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METALS & ALLOYS, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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Name.....

Position.....

Firm.....

Street & No......

City..... **State**.....